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Do High and Volatile Levels of Public Investment Suggest Misconduct?

The Role of Institutional Quality

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Abstract

This paper investigates the impact of institutional quality on public investment levels over the period 1984–2008. Moreover, it studies how the volatility of public investment and the quality of infrastructure are affected by institutional quality, and explores the contribution of other critical factors. The findings suggest an inverse relationship between public investment levels and institutional quality, supporting the idea that governments use public investment as a vehicle for rent-seeking or to compensate for the fall in private investment due to the poor business environment. In addition, aid flows, revenues and abundance of natural resources contribute positively to the level of capital spending. The author also finds that high volatility of public investment is associated with a lower quality of governance. An increase in revenues is associated with a reduction in the volatility of capital spending, suggesting that proper macroeconomic management smoothes the investment cycle. Finally, the paper provides some tentative evidence of a positive relationship between institutional quality and the quality of infrastructure.

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Do High and Volatile Levels of Public Investment Suggest Misconduct? The Role of Institutional Quality

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1. Introduction

During the global financial crisis, many governments employed unprecedented fiscal stimulus packages aimed at sustaining employment and spurring economic growth. The ability to select appropriate public investment projects and implement them quickly, however, varied significantly and in the aftermath of the crisis there have been strong concerns about the efficiency of capital spending. Moreover, advanced and emerging economies with large current account surpluses are often called to accelerate the global rebalancing by shifting demand from foreign to domestic markets. Consequently, public investment has received a lot of attention in recent years, as it is commonly seen as a potential tool to narrow imbalances.

Beyond these growth enhancing and stabilization functions, the role of the public sector in closing the massive infrastructure gaps in many developing countries has been widely acknowledged. For example, the United Nations Millennium Project (2005) called for a "big push" in key infrastructure investment to help countries meet the Millennium Development Goals.[2] As a result, there has been a renewed focus to strengthen the public investment management (PIM) system in many countries.

Institutions play a critical role in determining whether public investment spending will generate sustainable productive assets, or be inefficient and wasteful. For example, institutional mechanisms dictate whether projects undergo a rigorous cost-benefit analysis to evaluate their social and economic value, whether they are implemented on time, whether there are legitimate procurement practices, whether they adhere to their projected costs, and whether they are adequately maintained. In settings with weak institutions, there is a strong risk that public investment will be used to serve the ruling elite. Moreover, if politicians seek as many rents as are compatible with remaining in power, the amount of rent-seeking should vary in presence of partisan and electoral shocks (see Persson and Tabellini, 2000). The latter are likely to be more frequent in countries with weak institutional quality (e.g. without strong parties that tie people's electoral preferences), positively affecting the volatility of capital spending.

This paper expands upon Keefer and Knack's (2007) cross-country analysis into the impact of institutional quality on public investment levels by using a more recent and longer time period 1984-2009, and a broader sample within a panel framework. Additionally, it extends their research by studying how the volatility of capital spending and the quality of infrastructure are affected by institutional quality, and by exploring the contribution of other important factors such as conflict, aid, revenues and natural resources.

Our findings suggest a negative relationship between public investment levels and institutional quality. At the same time, aid, revenues and natural resources contribute positively to capital spending, even though there are no higher effects in resource rich countries with low quality of governance. These results suggest that governments use public investment spending as a vehicle for rent-seeking. Alternatively, they could imply that governments might increase public investment to compensate for the fall in private investment due to the country's inability to create an attractive business environment.

We also find that high volatility of public investment is associated with lower quality of governance, possibly because of more frequent political shocks. While aid flows and natural resource abundance increase the volatility of public investment, growth in revenues is associated with its reduction, suggesting a good macroeconomic management that results in a smoother investment cycle.

[2] More recently, Foster and Briceño-Garmendia (2010) estimate that Africa's infrastructure needs are around $93 billion a year.

Finally, we provide some tentative evidence of a positive effect from quality of governance on the quality of infrastructure. In general, these results cast doubts on the real contribution of the government sector to GDP and on the last as a measure of value added.

Section 2 presents some stylized facts concerning public investment and institutional quality. Section 3 summarizes the cross-country empirical literature. Section 4 describes our panel dataset, the estimation strategy and the empirical results. Section 5 assesses the policy implications of the findings and provides a brief conclusion.

2. Stylized Facts

Table 1 reports the average levels of public investment over both GDP and total investment for each quartile of the distribution for both a quality of governance index and a measure of government's checks and balances.[3] Public investment levels are somewhat stable for the first three quartiles of quality of governance, averaging 6.5 percent for public investment as a share of GDP and 33.9 percent for the ratio of public investment to total investment. The fourth quartile displays much lower values for both ratios, 4.3 percent and 18.7 percent respectively, suggesting that countries with the highest quality of governance scores spend less in public investment relative to the other countries.

For checks and balances, the pattern is similar, as the level of public investment over GDP (total investment) steadily decreases from an average of 8.2 (38.1) percent of GDP in the first quartile to 5.3 (26.6) percent of GDP (total investment) in the fourth quartile. The third quartile reports slightly lower values than the fourth one, but this may be also due to the dramatic reduction in the number of observations from the second to the last quartile.

The negative correlation between institutional quality and public investment levels can also be observed in the scatter plots in Figure 1, which also show the probability density functions for both the institutional quality variables. While quality of governance exhibits a Gaussian function, with a thicker right tail (including OECD countries), the figure for checks and balances displays a very different shape, suggesting a much higher number of countries with low scores.

[Table 1 about here]

[Figure 1 about here]

Table 2 presents the average volatility of public investment per quartile of quality of governance and checks and balances. Both ratios of public investment show a decreasing trend as we move from the first to the fourth quartile, suggesting a negative relationship between the two variables. On average, countries belonging to the first quartile experience more than twice as much volatility in public investment than the countries belonging to the fourth quartile.

[3] The observations for quality of governance and checks and balances used for the quartile analysis are the same ones employed in the regression analysis of public investments on quality of governance and checks and balances only, respectively.

Despite the reduction of observations in the last two quartiles of checks and balances, the picture is broadly the same. The scatter plots in Figure 2 confirm the negative relationship.

[Table 2 about here]

[Figure 2 about here]

Finally, Table 3 shows the averages of infrastructure quality per quartile of quality of governance and checks and balances. Three indicators that proxy the quality of infrastructure in transport, energy and telecommunications were selected: paved roads as a percentage of total roads, electric power system losses as a percentage of total power outputs, and faults per 100 main fixed lines per year. The latter two indicators were rescaled such that higher values mean higher quality.[4]

The quartile analysis reveals that infrastructure quality is positively correlated with institutional quality. These findings are true for all the indicators, but the changes from quartile to quartile are more dramatic for paved roads as a percentage of total roads. Figure 3 corroborates these results by displaying the scatter plots with a positively sloped prediction line for all combinations of both infrastructure and institutional quality indicators. Interestingly, the shape of the probability density functions for the infrastructure quality indicators have significant differences. While there are very few observations recording low quality values for the energy and telecommunications sectors, the points for the transport sector show much more variance.

[Table 3 about here]

[Figure 3 about here]

3. A Review of the Literature

Numerous papers have been written about the contribution of public investment to economic growth and poverty reduction, but the relationship, though generally positive, has not been conclusive.[5] Part of the reason can be attributed to the difficulty in differentiating between types of public investment. For example, one would expect the impact to be contingent upon the kind of public investment, the amount of investment, the initial stock of public capital, the economic context in which investment occurs (Anderson et al., 2006), as well as the quality of the investment.

[4] Further details about the choice of measures are provided in Section 4.

[5] Comprehensive surveys of the literature can be found in Estache (2006), Romp and de Haan (2007) and Straub (2008). A more recent contribution addressing many of the limitations of the previous studies is Calderón and Servén (2011).

Unlike much of current spending, the budget for public investment spending and the selection of projects can be varied with ease, and thus provides more opportunity to be influenced by capricious behavior and corrupt politicians and officials (Haque and Kneller, 2008). For example, project selection "may be based on who offers the best kickbacks to officials, rather than who offers the best price-quality combination, or entire public programs may be chosen more for their capacity to generate illegal income than for their potential to improve standards of living" (Haque and Kneller, 2008). Therefore, the impact of public investment on capital accumulation is often distorted by a high degree of inefficiency, waste, or corruption (Dabla-Norris et al., 2011).

Rajaram et al. (2010) provide examples of low public investment efficiency: poor project selection, including wasteful "white elephant" projects; delays in design and completion of projects; corrupt procurement practices; cost over-runs;[6] incomplete projects; and failure to operate and maintain assets effectively so that the benefits are less than they should be. A recent report by the World Bank (2011) states that corruption in the road sector is a problem for both developed and developing countries, yet the economic and social loss is more profound for poor communities in developing countries. A study by the Auditor General of Zambia (Government of Zambia, 2010) finds that the use of substandard materials during contract implementation is pervasive in the road sector, with every project surveyed having less cement content than specified.[7] There is also sufficient evidence to suggest that collusion positively affects tender prices for road construction[8] and that the impact in developing countries is significantly greater, with estimates above competitive prices of 15 to 60 percent in Tanzania in the 1990s (Government of Tanzania, 1996) and 30 percent in Romania (Oxford Business Group, 2004).

Measuring the quality of infrastructure stocks, however, is not straightforward. Tanzi and Davoodi (1997) use five measures of infrastructure quality: paved roads in good condition as a percentage of total paved roads; electric power system losses as a percentage of total power output; telecommunication faults per 100 mainlines per year; water losses as a percentage of total water provision; and railway diesels in use as a percentage of total diesel inventory. Unfortunately, this data is no longer available for a wide range of countries. Calderón and Servén (2004), similarly, provide some preliminary evidence on infrastructure quality in Latin America. They construct a synthetic measure of infrastructure quality by using three indicators: waiting time (in years) for the installation of main telephone lines, the percentage of transmission and distribution losses in the production of electricity, and the share of paved roads in total roads. The country and temporal coverage for these indicators, however, is limited.

As an indirect way to measure infrastructure quality, a growing strand of the literature has focused on the quality of government institutions. Charkabotry and Dabla-Norris (2009), for example, develop a theoretical endogenous growth model to show that development levels, corruption, and poor investment quality are often interdependent. Their framework also illustrates that weaknesses in the efficiency of public investment reduce productivity, the return

[6] For example, Flyvbjerg (2003) finds that there were significant cost overruns, waste, and delays with mega infrastructure projects.

[7] Additionally, contracts are affected by the following defects of projects: improperly sized aggregate particles (44 percent), too much clay (75 percent), aggregates did not meet crushing strength (67 percent), base thinner than required (81 percent), surface dressing layers thinner than required (82 percent), concrete samples weaker than required (50 percent).

[8] Prices increased by 8 percent in Florida (Gupta, 2001), 15 percent in South Korea (Lee and Hahn, 2002) and as high as 20 percent in the Netherlands (Van Den Heuvel, 2006).

to private investment, and the degree of specialization, thus decreasing the rate of economic growth.

Public investment in resource-rich settings raises an important set of questions about the relationship between observed public expenditure levels and institutional quality. A significant strand of the policy advice suggests that oil and gas exporters should translate rents into investment for infrastructure. However, there is some evidence that this spending is often poor, in part because of the high volatility in resource revenues (Gelb and Grassman, 2010), and that institutional indicators for these settings tend to be lower (Leite and Weidmann, 1999). This presents a double bind: resource rich-settings have both rents that should be leveraged for greater public investment but also potentially relatively weaker institutional settings.

In the empirical literature, several studies have incorporated measures of corruption and institutional quality. Dal Bó and Rossi (2007) use a panel dataset of eighty electricity distribution firms from thirteen Latin American countries, and their regression results identify a robust negative relationship between corruption and firm efficiency. Haque and Kneller (2008) use a three-stage regression to show that corruption increases public investment, but lowers its rate of return on economic growth. Delavallade (2006) applies a three-stage least squares analysis to a panel of 64 countries from 1996 to 2001, and finds that higher corruption distorts spending away from social expenditures (health, education, and social protection) towards other public services, order, fuel, and energy. The author argues that social sectors may offer less opportunity for embezzlement. Cavallo and Daude (2008) use a system generalized methods of moments (GMM) estimator on a panel of 116 developing countries between 1980 and 2006 to test whether public investment crowds-out private investment. They find that there is generally a strong crowding-out effect, but this effect is reduced in countries with higher scores on the International Country Risk Guide (ICRG)'s index of Political Risk.[9]

Another piece of the literature focuses on the institutional context in which public investment decisions are undertaken. Tanzi and Davoodi (1997) use a 1980-1995 panel dataset and find that higher levels of corruption are associated with higher levels of public investment, lower levels of operation and maintenance expenditure, and a lower level of infrastructure quality. In the same vein, Keefer and Knack (2007) investigate whether institutional quality is associated with higher levels of public investment. Using a 1974-1998 averaged cross-sectional dataset and an instrumental variables approach, the authors find that public investment is higher in countries with weak governance institutions or more limited checks and balances on governments. These results support the argument of Pritchett (2000) that cost and capital value of public investment are different concepts and that developing countries have created only little useful capital.

The specific linkage between institutional quality and volatility of capital spending has not been studied in the literature. However, Rodrik (2000), Quinn and Wooley (2001), and Mobarak (2005) all identify a negative relationship between democracy and volatility of economic growth across countries, and Dutt and Mobarak (2007) reveal that democracies are characterized by more stable policy choices. The idea is that the dispersion of decision-making authority (embedding a system of checks and balances, or veto-players) is a determinant of the stability observed in democracies, with respect to both policy and outcomes. The reasons are two. First, in a context of checks and balances policymakers need to obtain cooperation and approval of others. Second, such dispersion of authority mitigates the information problem, as

[9] The Political Risk index includes the following dimensions: government stability, corruption, bureaucracy quality, law and order, and political conflict.

more signals are brought to bear on choices than in an autocratic government (Coates et al., 2008).

4. Empirical Analysis

The empirical analysis tests the following set of hypotheses:

(i) Public investment levels are higher in countries with low institutional quality.
(ii) Public investment volatility is higher in countries with low institutional quality.
(iii) Infrastructure quality is higher in countries with high institutional quality.
(iv) High aid flows, revenues, and natural resources positively affect both the levels and volatility of public investment.
(v) Public investment levels are higher in resource rich countries with low institutional quality.
(vi) Corruption is an important channel through which quality of governance affects public investment levels (following Tanzi and Davoodi, 1997, and Mauro, 1998).

4.1. Data

We construct an annual panel dataset for 144 countries over the period 1984-2008 to exploit both cross-sectional and time series variation. The dataset encompasses country-level public investment and quality of infrastructure data, several measures of institutional quality, and a set of control variables (see Table 4). A brief description of the variables used in the analysis is provided below, while a more comprehensive list with sources and descriptive statistics is found in Table A of the Appendix.

[Table 4 about here]

Deviating from Keefer and Knack (2007), we use gross public fixed capital formation from the IMF's World Economic Outlook (WEO) database as a measure of public investment. Public gross fixed capital formation is referred to the general government sector, excluding public corporations.[10]

We normalize public investment by GDP and by total investment.[11] Although some countries have missing observations, the majority of countries have the full panel set and this ensures that all regions of the world are well represented.

In order to understand how the variance of public investment is affected by institutional quality, we define volatility of public investment as the absolute value of the percentage change in the deviation of the ratio of public investment to GDP and total investment, x_{it}, from the trend component extrapolated using the Hodrick-Prescott (HP) filter[12], $\tau_{x,it}$, minus the same deviation at time $t-1$, normalized by the trend at time $t-1$:

[10] Keefer and Knack (2007) use the IMF's Government Finance Statistics (GFS) central government capital expenditure data (not including investments by state-owned enterprises). The limited temporal coverage of GFS does not permit the authors to take into account the longitudinal dimension, thus they perform an average cross-sectional analysis over the period 1974-1998. Other data sources include the IMF Article IV country reports, which unfortunately are not available on a regular basis.

[11] As a robustness check public investment has also been normalized by general government total expenditure.

[12] For the HP filter the smoothing parameter, λ, has been set to 6.25.

$$PublicInvestmentVolatility_{it} = \left| \frac{[(x_{it} - \tau_{x,it}) - (x_{it-1} - \tau_{x,it-1})]}{\tau_{x,it-1}} * 100 \right| \qquad (1)$$

As observed by Mandelbrot (1963), volatility is likely to show some form of clustering. The simple computation of deviations from the trend component of a series in year t could have led to biased results if, for example, large changes tend to be followed by large changes of either sign. The Autoregressive Conditional Heteroskedasticity (ARCH) (Engle, 1982) and Generalized ARCH (GARCH) (Bollerslev, 1986) models aim to describe more accurately the phenomenon of volatility clustering and related effects such as kurtosis. These two widely-used models assume that volatility is dependent upon past realizations of the variable in question and related volatility process.

Even though ARCH/GARCH family models are superior tools for modeling volatility, the frequency of investment data prevents us from using them. The definition employed in our study, however, should account for volatility clustering to some extent, by referring to the local trend. Rolling windows of standard deviations are another option, but they imply the loss of observations, the introduction of an autoregressive pattern and a reduction of the series variation. Thus, they have only been used as a robustness check.

We follow Calderón and Servén (2004) to identify some measures of infrastructure quality. More specifically, we employ paved roads as a percentage of total roads for the quality of services in transport and electric power system losses as a percentage of total power outputs for quality of services in energy. Instead of using the waiting time for telephone main lines in years for telecommunications, we rely on faults per 100 main fixed lines per year.[13] We do not, however, construct a synthetic measure of infrastructure quality because principal components regression (PCR) suffers from several shortcomings. Hadi and Ling (1998) illustrated that the first $(p-1)$ principal components can totally fail in accounting for the variation in the response variable, which may fit perfectly the last principal component that is always ignored by the PCR.[14] Thus, we use the three variables as three different dependent variables. For ease of interpretation of the regression results, we rescaled electric power system losses and faults per 100 main fixed lines so that higher values indicate higher infrastructure.

In recent years, there has been a proliferation of cross-country governance indicators that measure the quality of public financial management (PFM) and PIM systems[15]. However, these indicators are typically only available for one or very few years, and at most for a limited number of countries. Thus, we draw from Keefer and Knack (2007) and construct the quality of governance indicator as an additive index of ICRG's measures. More specifically, we used only three of the five underlying variables adopted by the authors, namely corruption, bureaucracy quality and law and order tradition of the country, as data on the risk of expropriation and repudiation of contracts by government are not available for the period considered. However, as

[13] An argument could be made that investment in electricity and communication are also carried out by the private sector. However, it could be argued that good institutional quality is likely to be reflected in higher private investment levels and better quality.

[14] Hadi and Ling (1998) also argue that using principal components, the increase in the resulting sum of squared errors may be grossly discrepant with the magnitudes of the eigenvalues in the principal component decomposition of the independent variables' space. They conclude that there may not be any improvement on numerical accuracy via the PCR procedure.

[15] Public Expenditure and Financial Accountability (PEFA) indicators, Quality of Budget Institutions (see Dabla-Norris et al., 2010), PIM Index (see Dabla-Norris et al., 2011).

an alternative measure, we construct the quality of governance wide index, which also includes indicators for government stability and democratic accountability.

Among the ICRG subcomponents, the measure of corruption is defined as actual or potential corruption in the form of excessive patronage, nepotism, job reservations, "favor-for-favors", secret party funding, and suspiciously close ties between politics and business. Moreover, it also considers demands for special payments and bribes connected with import and export licenses, exchange controls, tax assessments, police protection, or loans.

High bureaucracy quality is likely to be positively correlated with less revisions of policy when governments change. Therefore, ICRG gives high scores to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. These countries are typically characterized by an autonomous bureaucracy from political pressure and by established mechanisms for recruitment and training.

ICRG's indicator of law and order assess each sub-component separately. The law sub-component is an assessment of the strength and impartiality of the legal system, while the order sub-component is an assessment of popular observance of the law.

The government stability indicator is an assessment both of the government's ability to carry out its declared programs, and its ability to stay in office. The subcomponents are government unity, legislative strength, and popular support. When these score high, the system is likely to look orderly and legislation more comprehensive, thus deviations from a disciplined behavior should result in a reduction and rules are more binding.

Finally, institutional quality is also affected by democratic accountability, which measures how responsive the government is to its people. Ideally, the less responsive it is, the more likely it is that the government will fall; the more responsive it is, the higher the satisfaction of the people and the smaller the incentive to deviate from the "good behavior". Therefore, ICRG awards points on the basis of the type of governance enjoyed by the country in question (alternating democracy, dominated democracy, *de facto* one-party state, *de jure* one-party state and autarchy).

The indexes quality of governance and quality of governance wide are scaled from 0 to 30 and from 0 to 50, respectively, with subcomponents rescaled from 0 to 10. The pair-wise correlation coefficient is 94.4 percent. As in Keefer and Knack (2007), the indexes should proxy the incentives of governments to seek rents and to prevent the reforms that would limit their ability to do so.

The composed indexes are more instructive than the subcomponents on their own and the reasons are multifold. As noted by Keefer and Knack (2007), corruption is not a necessary condition for rent-seeking, in fact incentives for politicians to deviate from a disciplined behavior may be legal and, at the same time, institutions might reduce rent-seeking even when corruption is high for other reasons. Moreover, a strong and impartial legal system that is observed by the population does not guarantee absence of rent-seeking behaviors, especially when the law does not cover all the potential distorting practices. Similarly, a stable government or a high democratic accountability on their own may not be good quality proxies to induce "good behavior". All these considerations make clear that a composite index is superior, however the single contribution of each subcomponent is analyzed by running *ad hoc* regressions.

North and Weingast (1989) and Acemoglu et al. (2001) argue that incentives to extract rents from citizens vary with the presence of political checks and balances and electoral competition. More specifically, governments might restrict citizens' influence on political

decisions and careers in order to prevent their access to the sources of rents (e.g. natural resources) when political checks and balances are low and electoral competition is absent.

As in Keefer and Knack (2007) we adopt the measure checks and balances cum elections from the Database of Political Institutions (DPI).[16] This measure is a function of the number of parties in the government coalition (for parliamentary systems), whether the president's party has a majority in the legislature (presidential systems), whether elections are governed by closed-list or open-list rules (with the former granting more authority to the heads of parties), and of the DPI's legislative index of electoral competitiveness.

The use of formal checks and balances presents, however, some limitations. Since it is only one of many possible political determinants of low institutional quality, the results are unlikely to be as strong as for quality of governance. Moreover, this measure draws on a fixed view of organization of government and some checks and balances may be hard to observe.

We would expect both quality of governance and checks and balances to show little variation over time and great variation across countries. However, the relatively wide time span allows the within standard deviation to be almost half of the across standard deviation (2.6 against 5.6) for quality of governance[17] and nearly the same for checks and balances (1.3 against 1.0), justifying the panel analysis.

A set of other factors is likely to impact the quantity and the volatility of public investment. As observed in Knack and Keefer (2007), left-leaning governments might prove more prone to intervene in the economy and favoring more redistribution as opposed to right governments, therefore increasing the volatility of public investment. Thus, a dummy variable that takes the value one if the largest party in the legislature is coded in DPI as left-leaning, and zero otherwise, is used.

Price of investment goods is another key determinant of public investment. When prices are high, the ratio of public investment to GDP is expected to decrease, however this might not be true for the ratio of public investment to total investment. If private investors are more sensitive to price variations than the public ones, we could observe an increase in the ratio of public investment to total investment.

Economic income and country size are expected to have some impact on public investment. Standard macroeconomic theory would predict a positive effect from income, nonetheless it is common for developing countries to spend more relative to the GDP or total investment than advanced economies to foster the catch up process, or as a result of rent-seeking activities. At the same time, bigger countries are expected to invest more than smaller ones because they generate a stronger demand, thus population is introduced as a time-varying measure of country size.

Differently from Keefer and Knack (2007), we control for a set of additional covariates that are expected to have important effects on the dependent variables. Conflicts depress economic activity as well as public investment because resources are typically diverted towards defense and military activities, thereby increasing the volatility. Thus, drawing from the Centre for the Study of Civil War (CSCW) dataset, we create a dummy variable that takes the value one if there are at least 1,000 battle-related deaths, zero otherwise.

Overseas Development Assistance (ODA) net disbursements can be used by the government to invest or free up government resources that can be directed toward public investment, therefore exerting a positive impact (Sturm, 2001). At the same time, the

[16] As an alternative measure we adopt a laxer version of checks and balances cum elections.
[17] Within/across relative variation is even higher for quality of governance wide (4 against 7.5).

unpredictability of aid flows is likely to be reflected in the macroeconomic and fiscal environment of the country. Hence, we take the ratio of ODA net disbursements to GDP.

Likewise, the relief obtained under the Heavily Indebted Poor Countries (HIPC) initiative could push governments to allocate more resources from the debt service to public investment. Hence, a dummy variable to control for such allocation changes is introduced. This takes the value one if the country is in the period between the decision point and the completion point of the original or enhanced HIPC initiative, zero otherwise.

Along the same reasoning, the ratio of central government total revenues and grants as a percentage of GDP is introduced. Increased revenues are likely to affect positively the levels of public investment (Tanzi and Davoodi, 1997) and, at the same time, increase the volatility of public investment if the government tends to spend the new money. However, if the government is conservative and builds up a buffer to implement counter-cyclical fiscal policy, the effect on the volatility could turn out to be negative.

On the one hand, natural resources rich countries are likely to foster the investment activity both by building up infrastructure to further exploit and generate profits from such richness, and by diversifying the productive structure. On the other hand, the price fluctuations affect quantities sold and may eventually be reflected in the volatility of public investment. Unfortunately, data restrictions do not allow controlling for the overall natural resource endowments and the ratio of oil exports to GDP is typically used to proxy it to some extent. Nonetheless, oil is just one albeit important of the resources a country may be endowed with and there are cases of countries that are resource rich but do not export the commodity. In order to take into account these considerations, we employ the sum of the rent from energy depletion (crude oil, natural gas, hard coal, and lignite) and rent from oil and minerals (bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin, zinc). Each rent is computed as production volume multiplied by the difference between international market price and average unit production cost.[18]

4.2. Empirical Strategy

While Knack and Keefer (2007) use an averaged cross-section to investigate the impact of institutional quality on public investment, we employ the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998).

Our methodology can be considered superior as it exploits the longitudinal dimension and, as specified by Roodman (2006), jointly addresses several potential econometric problems since it is specifically designed for situations with (1) few time periods and many individuals; (2) a linear functional relationship; (3) a single left hand side variable that is dynamic, depending on its own past realizations; (4) independent variables that are not strictly exogenous (possibly correlated with past and current realizations of the error); (5) unobserved heterogeneity at country level; (6) and heteroskedasticity and autocorrelation within individuals, but not across them.

Given our dataset spanning 144 countries over 25 years, a typical persistence in the investment variable, some of the explanatory variables (income and price in particular) that may be endogenous with public investment, a likely presence of specific country fixed effects, and idiosyncratic errors that are heteroskedastic and correlated within but not across individuals, the system GMM is instrumental in addressing all these issues.

To test hypothesis (i) we adopt the same specification as in Keefer and Knack (2007):

[18] Oil exports have been used as a robustness check.

$$PubInvShare_{i,t} = \alpha + \beta_1 InstitutionalQuality_{i,t} + \beta_2 Population_{i,t} + \beta_3 LeftistParty_{i,t} + \beta_4 PriceofInv_{i,t} + \beta_5 GDPpcPPP_{i,t} + v_i + \tau_t + u_{it} \quad (2)$$

where the dependent variable $PubInvShare_{i,t}$ is the ratio of public investment to GDP or to total investment; $InstitutionalQuality_{i,t}$ is quality of governance or political checks and balances; $Population_{i,t}$ is the natural logarithm of population in millions; $LeftistParty_{i,t}$ denotes a left-leaning party as the largest party in the legislature; $PriceofInv_{i,t}$ is the price of investment relatively to the United States; $GDPpcPPP_{i,t}$ is the growth rate of GDP per capita in PPP terms[19]; $v_i$is a set of unchanging country specific effects (proxied by country dummies); τ_t are effects common to all countries in period t (time dummies); and u_{it} is the error term. All the controls are added once at time to check whether results are robust to the progressive loss of observations.

In order to eliminate the country-effects, we take first differences of equation (1), which yields:

$$PubInvShare_{i,t} = \varphi PubInvShare_{i,t-1} + \beta_1 \Delta InstitutionalQuality_{i,t} + \beta_2 \Delta Population_{i,t} + \beta_3 \Delta LeftistParty_{i,t} + \beta_4 \Delta PriceofInv_{i,t} + \beta_5 \Delta GDPpcPPP_{i,t} + \Delta\tau_t + \Delta u_{it} \quad (3)$$

The differentiated error term Δu_{it} is correlated with the lagged dependent variable $PubInvShare_{i,t-1}$ by construction. Thus, the difference GMM estimator uses a set of lagged explanatory variables to address this problem and the endogeneity of some covariates.[20]

However, in presence of high persistence in the levels of the explanatory variables (with levels being weak instruments of the first differences) and small samples, the estimation of equation (3) would produce biased estimates. Differently, the system GMM assumes a further moment restriction, namely that although explanatory variables might be correlated with the unobservable component v_i, the first differences are uncorrelated with $v_i + u_{it}$. Therefore, lagged first differences can be used as instruments for the levels of equation (2). In this setting, we can estimate a system GMM with the level equation (2) and its differenced form (3), under the mentioned moment assumption.

As suggested in Roodman (2006), we include year effects to control for global factors. The autocorrelation test and the robust estimates of the coefficient standard error assume no correlation across individuals in the idiosyncratic disturbances and the introduction of time dummies makes such assumption more likely to hold.

[19] Fisher panel data unit root test could not reject the null hypothesis that all panels contain unit roots for GDP per capita in PPP terms. On the contrary, the null hypothesis is rejected when the growth rate of the same variable is considered.

[20] The estimation procedure exploits lagged instruments that are weakly exogenous if they are not correlated with future error terms. The lagged dependent variable is "predetermined" as it is correlated with past error terms, but uncorrelated with the current and future error terms. However, the other variables are potentially endogenous given that they are correlated with the current and past error terms, but are assumed to be uncorrelated with future errors. In other words, predetermined and endogenous variables are uncorrelated to unanticipated shocks (future error terms), albeit expected future dynamics may affect them. Therefore, a set of instruments is given by the lagged levels.

To check whether the assumptions have been respected, we perform a second-order serial correlation test and a Hansen J-test. The first is ensuring that Δu_{it} is uncorrelated with Δu_{it-2}, whereas the second is testing for over-identifying restrictions, that is whether the instruments, as a group, appear exogenous.[21] As argued in Roodman (2006), Hansen J-test can be greatly weakened by instrument proliferation, hence we collapse the instrument matrix into a vector.

Deviating from Keefer and Knack (2007), the dependent variable now becomes the volatility of public investment as previously defined to test hypothesis (ii) and the indicators of infrastructure quality to test hypothesis (iii). Moreover, variables for ODA, revenues and natural resources are added to the baseline specification to test hypothesis (iv). More formally, the following equation and its differenced form are estimated:

$$PubInvShare_{i,t} = \alpha + \beta_1 InstitutionalQuality_{i,t} + \beta_2 Population_{i,t} + \beta_3 LeftistParty_{i,t} + \beta_4 PriceofInv_{i,t} + \beta_5 GDPpcPPP_{i,t} + \beta_7 Conflicts_{i,t} + \beta_8 ODA_{i,t} + \beta_9 Revenues_{i,t} + \beta_{10} Rents_{i,t} + v_i + \tau_t + u_{it} \quad (4)$$

where $PubInvShare_{i,t}$ is the public investment ratios, the volatility of those ratios and the indicators of public investment quality previously defined. $Conflicts_{i,t}$ is a dummy variable for ongoing conflicts; $ODA_{i,t}$ is the share of net disbursements over GDP; $Revenues_{i,t}$ is the total of revenues and grants as a percentage of GDP; and $Rents_{i,t}$ is the value of the rents from energy depletion and oil and minerals. As for the estimation of equation (2) and (3), these controls are added one at time because they imply a partial loss of observations. Once again, equation (4) and its differenced form are estimated with $PublicInvestmentVolatility_{it}$ on the left hand side.

Hypothesis (v) is tested by introducing an interaction term between rents and quality of governance (or checks and balances) in equation (4). Since we expect resource rich countries with low (high) quality of governance to invest more (less), we should observe a negative coefficient on the interaction term.[22]

Finally, we test hypothesis (vi) by disaggregating the quality of governance additive indexes into their subcomponents and estimating equation (4) and its differenced form on them.

4.3. The Impact of Institutional Quality on the Levels of Public Investment

Keefer and Knack (2007) analysis is replicated in Table 5. Here we estimate the impact of institutional quality on the levels of public investment as specified in equation (2) and (3). The odd columns show the estimates for quality of governance and the even columns the ones for checks and balances, while the independent variables are added one at time. Both the measures of institutional quality exert a negative and significant impact on public investment as a share of GDP. In the most complete specification in column (7) (column (8)), a ten-point increase in the quality of governance (checks and balances) is associated with a reduction in public investment of 0.31 (0.96) percent of GDP.

These estimates are sensibly smaller than the ones obtained by Keefer and Knack (2007), and this is likely to be due to two factors. The authors were not able to exclude unobservable components and these might have simultaneously influenced average institutional quality and

[21] Hansen J-test is preferred to the Sargan one, as the latter is not robust to heteroskedasticity and autocorrelation.
[22] The same hypothesis is also tested by constructing the interaction term between rents and (i) a dummy variable that takes value one if the ratio of oil exports to GDP is higher or equal to 30 percent, zero otherwise; and (ii) a dummy variable for the Organization of Petroleum Exporting Countries (OPEC) membership, zero otherwise.

average public investment levels. Also, if part of the effect of institutional quality on public investment were only evident after a substantial lag, it would not fully show up in the GMM estimation results.

The covariates take the expected sign when significant. More specifically, the price of investment negatively affects the quantity and a leftist party invests more. The growth rate of income per capita turns out non-significant and the results are robust to its inclusion.

[Table 5 about here]

Table 6 shows the results employing the same specifications as in Table 5, but shifting the dependent variable to the ratio of public investment as a share of total investment. The results are consistent with those of the previous table. In the most complete specification in column (7) (column (8)) a ten-point increase in the quality of governance (checks and balances) is associated with a reduction in public investment of 2.35 (7.36) percent of total investment. Such reduction may be either compensated by an increase in private investment or be more dramatic than the fall of investments in the private sector.

Once again, the price of investment is negative and significant and so is the contribution brought about by the population variable in the equation for checks and balances.

[Table 6 about here]

Tables 7 and 8 present some extensions of the models estimated in Tables 5 and 6, respectively. More specifically, equation (4) and its differenced form are estimated for public investment as a share of GDP in Table 7, with independent variables added one at time. The results for quality of governance are consistent with the ones of Keefer and Knack (2007), as the most complete specification in column (9) suggests that a ten-point increase in the quality of governance is associated with a reduction in public investment of 0.42 percent of GDP. On the contrary, the negative coefficient on checks and balances is not statistically different from zero.

Among the regressors, conflicts show a negative and significant coefficient in column (9), implying that public investment is reduced if the country is involved in some sort of battle. Interestingly, resources seem to play a relevant role in fostering public investment. In column (9) (column (10)), a ten percent increase in ODA is associated with 0.3 (0.52) percent rise in public investment as a share of GDP. At the same time, the coefficient on revenues is positive and strongly significant, suggesting a growth in the public investment share between 0.41 and 0.44 percent due to a ten percent increase in revenues in the most complete specifications. Likewise, natural resources proxied by rents exert a positive, albeit smaller positive effect on the ratio of public investment to GDP. A ten percent increase in rents is associated with an increase in public investment between 0.17 and 0.28 percent of GDP.

[Table 7 about here]

When public investment as a share of total investment is used as dependent variable, as in Table 8, the results are mostly confirmed. The negative effect of quality of governance is significant and robust to the introduction of other regressors. In the preferred specification of column (9), a ten-point increase in quality of governance is associated with a reduction in public investment of 1.82 percent of total investment. Although the significance on the coefficient for checks and balances appears more robust to the inclusion of other regressors in this table than in Table 7, it is lost when rents are added to the specification in column (10).

The other independent variables confirm what expected. The price of investment is negatively correlated with the quantity of public investment, implying that public investment is more responsive than private investment to variations in price. Some positive effects are observed on the ODA and the revenues variables, but these are weaker and not always significant with respect to the ones observed in Table 7. Natural resources are still positively affecting public investment with an impact between 1.44 and 1.77 percent of total investment due to an increase of 10 percent in rents.

[Table 8 about here]

Results in column (1) and (2) of Table 9 reject the hypothesis that resource rich countries with low institutional quality invest more, as the coefficient on the interaction term is non-significant. The same hypothesis is rejected in column (3) and (4), where public investment is normalized by total investment.

[Table 9 about here]

Column (1) and (3) of Table 10 present the results for the subcomponents of the quality of governance indicator on both public investment ratios. Corruption seems to be the only channel through which quality of governance is significantly affecting the ratio of public investment to GDP. On the other hand, the ratio of public investment to total investment is negatively and significantly associated only with bureaucracy quality.

Government stability and democratic accountability are the additional subcomponents of the index quality of governance wide, thus not included in the quality of governance index used in the regressions of the previous tables. Even when such subcomponents are added, the negative impact of corruption and bureaucracy quality is confirmed. Moreover, column (2) shows that government stability is positively affecting public investment, suggesting that instability (proxied by government disarray, legislative weakness, and lack of popular support) is not a channel for misconduct.

[Table 10 about here]

Overall, the findings of Keefer and Knack (2007) are confirmed when the same specification is used in a panel setup, suggesting that capital spending may be used as a vehicle for rent-seeking in low institutional quality settings, or that public investment may compensate the low levels of private investments.

While quality of governance conserves a significant negative relationship with public investment, the negative effect exerted by checks and balances disappears when other controls are added.[23] ODA, revenues and natural resources contribute positively to capital spending. In line with Tanzi and Davoodi (1997) and Mauro (1998), we observe that corruption is associated, albeit weakly, with higher public investment as a share of GDP. However, the variable becomes insignificant when the dependent variable is the ratio of public investment to total investment.

4.4. The Impact of Institutional Quality on the Volatility of Public Investment

The estimates for the volatility of public investment are presented in Tables 11 and 12. Table 11 shows the impact of quality of governance and checks and balances on the volatility of the ratio of public investment to GDP, highlighting an unambiguous negative and significant impact of the former and a negative but weakly or not always significant impact of the latter. In our preferred specification of column (9), a ten-point increase in quality of governance is associated with a reduction in the volatility of public investment as a share of GDP of 4.58 percentage points.

Among the regressors, a higher population is associated with less volatility in public investment. The ODA variable presents a significant and positive coefficient in the most complete specifications. In other words, aid flows seem to increase the volatility of capital spending and this reflects the poor predictability of aid flows. Likewise, column (10) suggests that being a resource rich country significantly increases the volatility of public investment as expected. This may be due to the unpredictable revenues that the resource dependence generates, which increase the volatility of all spending.

Interestingly, revenue increases are associated with less volatility and this could be the result of the effect of automatic stabilizers or more generally improved macroeconomic management, however the coefficient is significant only in the even columns.

[Table 11 about here]

In Table 12 the dependent variable is the volatility of public investment as a share of total investment. Quality of governance and checks and balances affect negatively the volatility of public investment, but the effect of the latter is not different from zero in some specifications. More precisely, column (9) suggests that a ten-point increase in quality of governance is associated with a reduction in the volatility of public investment as a share of total investment of 4.58 percentage points.

The picture drawn by looking at the covariates does not change from the previous table. Population is still associated with lower volatility, whereas ODA and natural resource with higher volatility of public investment. The negative and significant coefficients for revenues in

[23] The results provide some evidence for the claim that checks and balances matter, though the effects are less significant than for quality of governance, as expected, or Keefer and Knack (2007).

column (8) and (10) suggest that revenues are well managed and translated in capital expenditures that smooth the investment cycle.

[Table 12 about here]

Finally, Table 13 presents the effects exerted by the subcomponents of quality of governance on the volatility of public investment. All the variables take the expected negative sign regardless of the ratio used as a dependent variable. The only significant effect on the volatility of the ratio of public investment to GDP is observed on law and order and, despite the large magnitude, it is only borderline significant in the specification that includes the subcomponents of quality of governance. When the dependent variable is the volatility of the ratio of public investment to total investment, the significant variable is bureaucracy quality.

[Table 13 about here]

In general, volatile public investment is associated with lower institutional quality, and similarly to what happened for the investment levels, quality of governance turns out to be robust to the inclusion of additional regressors. This result might be due to the fact that partisan and electoral shocks are more frequent in weak institutional quality countries, resulting in more variation in capital spending. Or more simply, if capital spending embeds more rent-seeking when institutional quality is weak, it should be more volatile.

Interestingly, while ODA and natural resources increase the volatility of public investment, an increase in revenues is associated with its reduction, implying a good macroeconomic management that results in a smoother investment cycle. Among the single subcomponents of quality of governance, law and order and bureaucracy quality seem to be the most affecting ones.

4.5. The Impact of Institutional Quality on the Quality of Infrastructure

Tables 14, 15 and 16 show the results for the effects of quality of governance on the quality of infrastructure. In Table 14, the dependent variable is paved roads as a percentage of total roads, proxying transport infrastructure quality. None of the regressors turns out significant, most likely because of the extremely low variation within countries, also observable by looking at the high coefficient for the lag of the dependent variable. Therefore, the between variation is captured by the fixed effects.

[Table 14 about here]

In Table 15 we employ electric power system losses as a percentage of total power outputs (rescaled) as a dependent variable. We observe that institutional quality is positively correlated with energy infrastructure quality. The effect becomes insignificant for checks and

balances only when all the regressors are included, even though the coefficient is close to the 10 percent significance threshold.

The most complete specification for checks and balances in column (10) shows a negative effect from ODA and a positive one from revenues. Moreover, resource rich countries experience lower levels of quality of energy infrastructure.

[Table 15 about here]

Finally, Table 16 presents the results for faults per 100 main fixed lines per year (rescaled), proxying quality in the telecommunications infrastructure. Quality of governance exerts a positive impact on the dependent variable, whereas checks and balances are positive but non-significant.

Once again, ODA and revenues are respectively and significantly negative and positive in the equations for checks and balances. During conflicts, interruptions in the telecommunications services are likely to happen and this is reflected in the negative and significant coefficient for some regressions.

[Table 16 about here]

When we disaggregate the quality of governance indicator into its subcomponents in Table 17, law and order displays a positive and significant effect on both energy and telecommunication infrastructure quality. Moreover, a positive contribution is observed also on bureaucracy quality when the dependent variable is the quality of energy infrastructure.

[Table 17 about here]

Although these results broadly confirm a positive relationship between infrastructure quality in some sectors and quality of governance, they should be taken cautiously. The poor data availability and the focus on some specific sectors are causes of concerns.

If these results were considered reliable, they would be inconsistent with the idea that public investment (in some infrastructure sectors) is offsetting private investment in weak institutional settings. If there was an authentic substitution, public investment quality (proxied by infrastructure quality) should be higher even at low levels of governance.

5. Conclusions

In this paper we conduct an empirical analysis of the impact of institutional quality on the levels of public investment. The investigation extends the cross-country analysis carried out by Keefer and Knack (2007) by looking at the more recent time span of 1984-2008, using a broader sample and by analyzing the effects of aid, revenues and natural resources. While the panel

dataset allows correcting for a set of relevant econometric issues, we also explore the effects of institutional quality on the volatility of public investment and on the quality of infrastructure and we look at which channel is contributing the most to the changes in these variables.

By and large, the findings of Keefer and Knack (2007) are confirmed when the same specification is used in a panel framework, suggesting an inverse association between public investment levels and institutional quality albeit with a smaller magnitude. Aid, revenues and natural resources abundance, on the other hand, contribute positively to capital spending, however there are no higher effects in settings where natural resources are high and institutional quality is low.

Contrary to Keefer and Knack (2007), we find some evidence of what has been argued in Tanzi and Davoodi (1997) and Mauro (1998) as our results suggest that corruption is the subcomponent of quality of governance that significantly contributes to the increase in the levels of public investment as a share of GDP. However, this is not true for the ratio of public investment to total investment, which is only significantly affected by bureaucracy quality.

These results support the idea that public investment can be used by governments as a vehicle for rent-seeking. If so, politicians are likely to push investment projects on the base of how much they can extract from them instead of looking at economic return and feasibility indicators. As a result, capital spending offers a misleading proxy for public capital stock, because of the misconduct surrounding project selection and government procurement practices that can vary substantially across countries and over time (see Pritchett, 2000). An alternative interpretation is that governments might increase public investment to compensate for the fall in private investment due to inability to create an attractive business environment.

Volatility of public investment is associated with lower institutional quality, suggesting that more frequent partisan and electoral shocks are likely to affect the size of the changes in capital spending. This result has operational relevance because highly volatile capital spending entails second-round effects on the required operation and maintenance expenditures. The variations of the latter adversely affect the contribution of public investment to development. Interestingly, while aid and natural resources increase the volatility of public investment, an increase in revenues is associated with its reduction, suggesting a proper macroeconomic management that results in a smoother investment cycle.[24] Among the single subcomponents of quality of governance, bureaucracy quality and law and order seem to be the most affecting ones.

Finally, as expected institutional quality is positively associated to some measures of infrastructure quality, and bureaucracy quality and law and order seem again to be the relevant subcomponents. This result would be inconsistent with the idea that public investment is offsetting the fall in private investment, since, if this was true, public investment quality should be high even when institutional quality is low. Nonetheless, these results should be treated cautiously because of data limitations.

These findings have policy implications. Public investment needs institutional capacity to be efficient. The pressure exerted by widening global imbalances and infrastructure gaps should be reduced through capital spending only when governments commit themselves to put in place policies that limit misconduct, in particular in the area of corruption, bureaucracy quality, and law and order. These should guarantee a higher quality of governance that is likely to promote less but higher quality and more productive public investment. At the same time, these reforms

[24] It could be argued that volatile capital investment is not necessarily a bad outcome as countries might enjoy lump sum investments that are still beneficial. However, in general terms a good macroeconomic management should smooth the business cycle and therefore organize the public investment activities over time.

are likely to generate less frequent partisan and electoral shocks and a better macroeconomic management resulting in lower volatility of capital spending.

The evidence suggests that GDP measures are likely to be overestimated for low institutional quality countries because the value added of public investment is lower than what is registered at cost. As stated in Stiglitz (2009), the increase in the share of government output in GDP in the last 60 years underscores the importance of addressing what he defined as "GDP Fetishism", by analyzing which is the real contribution of the government sectors to GDP.

Further research is needed to understand whether these results are evidence of rent-seeking behaviors or rather inability of the governments to create the appropriate business environment to foster private investment. Moreover, the relationship between quality of institutions and quality of infrastructure needs to be explored with better and more comprehensive data. Finally, it could be instructive to carry out in depth case studies for those countries that have weak institutional quality but do not produce opportunities for misconduct.

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Appendix

Table A: Variables and Sources

Variable	Source	Definition
Public Investment / GDP	WEO	Gross public fixed capital formation as a percentage of GDP.
Public Investment / Total Investment	WEO	Gross public fixed capital formation as a percentage of total investment.
Volatility of Public Investment / GDP	WEO	Absolute value of the percentage change in the deviation of the ratio of public investment to GDP, from the trend component extrapolated using the HP filter, minus the same deviation at time t-1, normalized by the trend at time t-1.
Volatility of Public Investment / Total Investment	WEO	Absolute value of the percentage change in the deviation of the ratio of public investment to total investment, from the trend component extrapolated using the HP filter, minus the same deviation at time t-1, normalized by the trend at time t-1.
Quality of Governance	ICRG	Additive index constructed with three ICRG variables: bureaucracy quality, corruption and law and order. These variables have been rescaled on a range 0 to 10, therefore the index is measured on a scale of 0 to 30, with higher values indicating better quality of governance.
Quality of Governance Wide	ICRG	Additive index constructed with five ICRG variables: bureaucracy quality, corruption, law and order, government stability and democratic accountability. These variables have been rescaled on a range 0 to 10, therefore the index is measured on a scale of 0 to 50, with higher values indicating better quality of governance.
Checks and Balances	DPI	Measure of Checks and Balances cum elections. This measure is a function of the number of parties in the government coalition (for parliamentary systems), whether the president's party has a majority in the legislature (presidential systems), whether elections are governed by closed-list or open-list rules (with the former granting more authority to the heads of parties) and of the DPI's legislative index of electoral competitiveness.
Checks and Balances Lax	DPI	Laxer measure of Checks and Balances cum elections.
Bureaucracy Quality	ICRG	Institutional strength and quality of the bureaucracy is a shock absorber that tends to minimize revisions of policy when governments change. In low-risk countries, the bureaucracy is somewhat autonomous from political pressure. This variable has been rescaled on a range 0 to 10.
Corruption	ICRG	A measure of corruption within the political system that is a threat to foreign investment by distorting the economic and financial environment, reducing the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability, and introducing inherent instability into the political process. This variable has been rescaled on a range 0 to 10.
Law and Order	ICRG	Two measures comprising one risk component. Each sub-component equals half of the total. The "law" sub-component assesses the strength and impartiality of the legal system, and the "order" sub-component assesses popular observance of the law. This variable has been rescaled on a range 0 to 10.
Government Stability	ICRG	A measure of the government's ability to stay in office and carry out its declared program(s), depending upon such factors as the type of governance, cohesion of the government and governing parties, approach of an election and command of the legislature. This variable has been rescaled on a range 0 to 10.
Democratic Accountability	ICRG	A measure of, not just whether there are free and fair elections, but how responsive government is to its people. The less responsive it is, the more likely it will fall. This variable has been rescaled on a range 0 to 10.
Population	WDI	Natural logarithm of populations in millions.
Leftist Party	DPI	Dummy variable that takes the value 1 if the largest party in the legislature is coded in DPI as left-leaning, zero otherwise.
Price of Investment Goods	Penn World Tables	Price level of investment goods in a country relative to prices in the United States, where the value is 100.

Table A: Variables and Sources *(continued)*

Variable	Source	Definition
Income per capita	WDI	Growth rate of GDP per capita in PPP terms.
Conflicts	CSCW	Dummy variable that takes the value one if there are at least 1,000 battle-related deaths, zero otherwise.
ODA	OECD	Overseas Development Assistance net disbursements as a percentage of GDP.
HIPC	World Bank	Dummy variable that takes the value one if the country is in the period between the decision point and the completion point of the original or enhanced HIPC initiative, zero otherwise.
Revenues	WEO	Central government total revenues and grants as a percentage of GDP.
Rents	World Bank	Sum of rent from energy depletion (crude oil, natural gas, hard coal and lignite) and rent from oil and minerals (bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin, zinc). The rent is computed as production volume multiplied by the difference between international market price and average unit production cost.
Paved Roads / Total Roads	WDI	Paved roads are those surfaced with crushed stone (macadam) and hydrocarbon binder or bituminized agents, with concrete, or with cobblestones, as a percentage of all the country's roads, measured in length.
Electric Power System Losses as a percentage of Total Power Outputs	WDI	The percentage of transmission and distribution losses in the production of electricity. This variable has been rescaled by subtracting each value to the maximum.
Faults per 100 main fixed lines per year	International Telecommunication Union	Ratio of the total number of reported faults for the year to the total number of main lines in operation and multiplying by 100. This variable has been rescaled by subtracting each value to the maximum.

Table 1: Public Investment per Quartile of Quality of Governance and Checks and Balances

	Obs.	Public Investment/GDP	Obs.	Public Investment/Total Investment
Quality of Governance				
1st quartile	590	6.4	598	34.7
2nd quartile	629	6.3	647	32.7
3rd quartile	586	6.8	587	34.3
4th quartile	554	4.3	559	18.7
Checks and Balances				
1st quartile	1028	8.2	1035	38.1
2nd quartile	998	6.1	988	31.8
3rd quartile	535	5.2	538	23.8
4th quartile	313	5.3	313	26.6

Notes: The observations are the ones used in the regressions of public investment on institutional quality without controls.

Figure 1: Scatter plots, Probability Density Functions and Linear Predictions of Public Investment levels and Institutional Quality

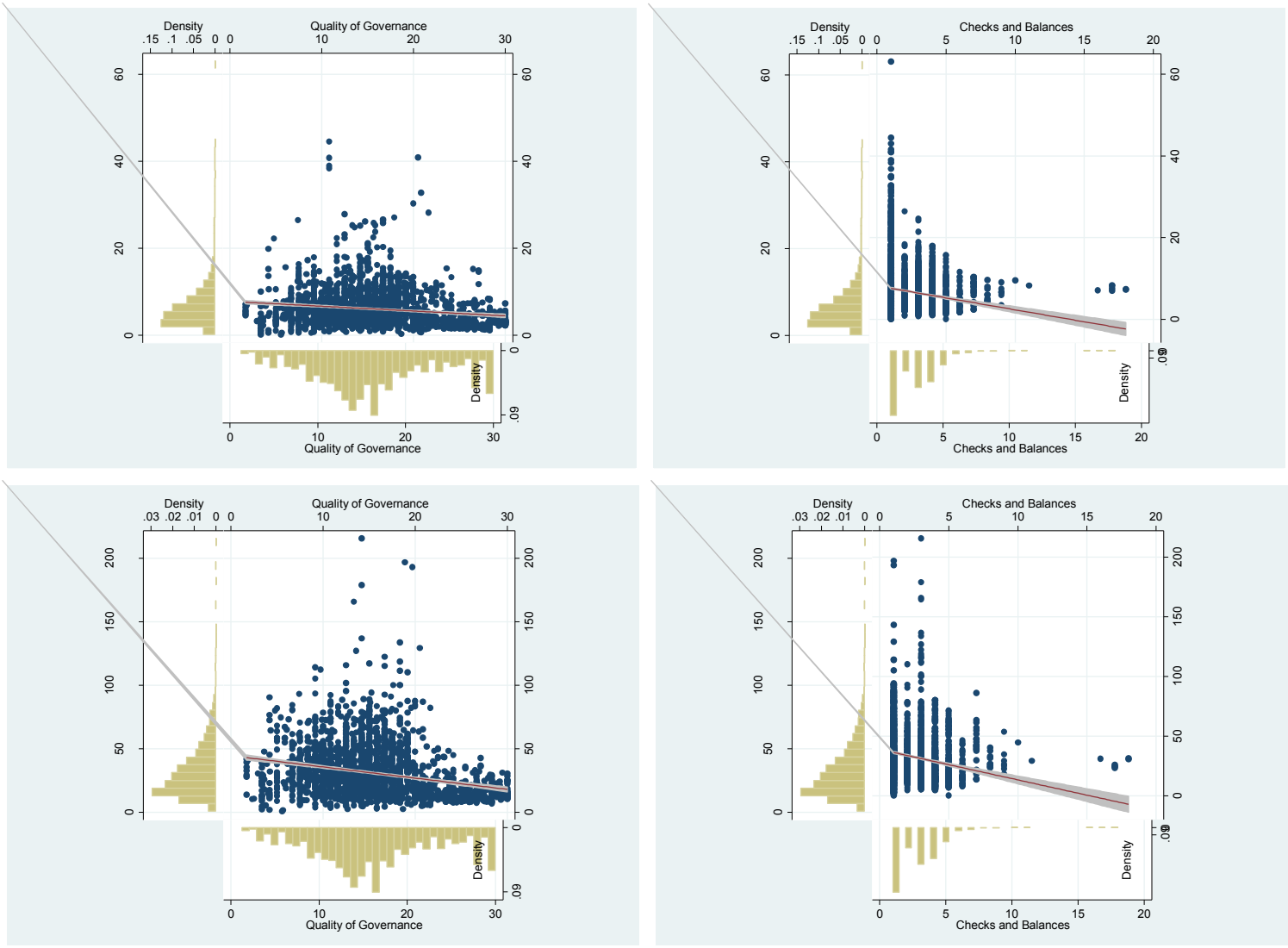


Table 2: Volatility of Public Investment per Quartile of Quality of Governance and Checks and Balances

	Obs.	Volatility of Public Investment/GDP	Obs.	Volatility of Public Investment/Total Investment
Quality of Governance				
1st quartile	581	19.0	589	18.5
2nd quartile	619	16.7	640	15.7
3rd quartile	580	15.2	581	14.4
4th quartile	538	8.0	544	8.3
Checks and Balances				
1st quartile	1022	19.6	1011	18.0
2nd quartile	980	15.4	973	14.9
3rd quartile	527	12.8	532	13.2
4th quartile	306	10.6	306	10.5

Notes: The observations are the ones used in the regressions of the volatility of public investment on institutional quality without controls.

Figure 2: Scatter plots, Probability Density Functions and Linear Predictions of Public Investment volatility and Institutional Quality

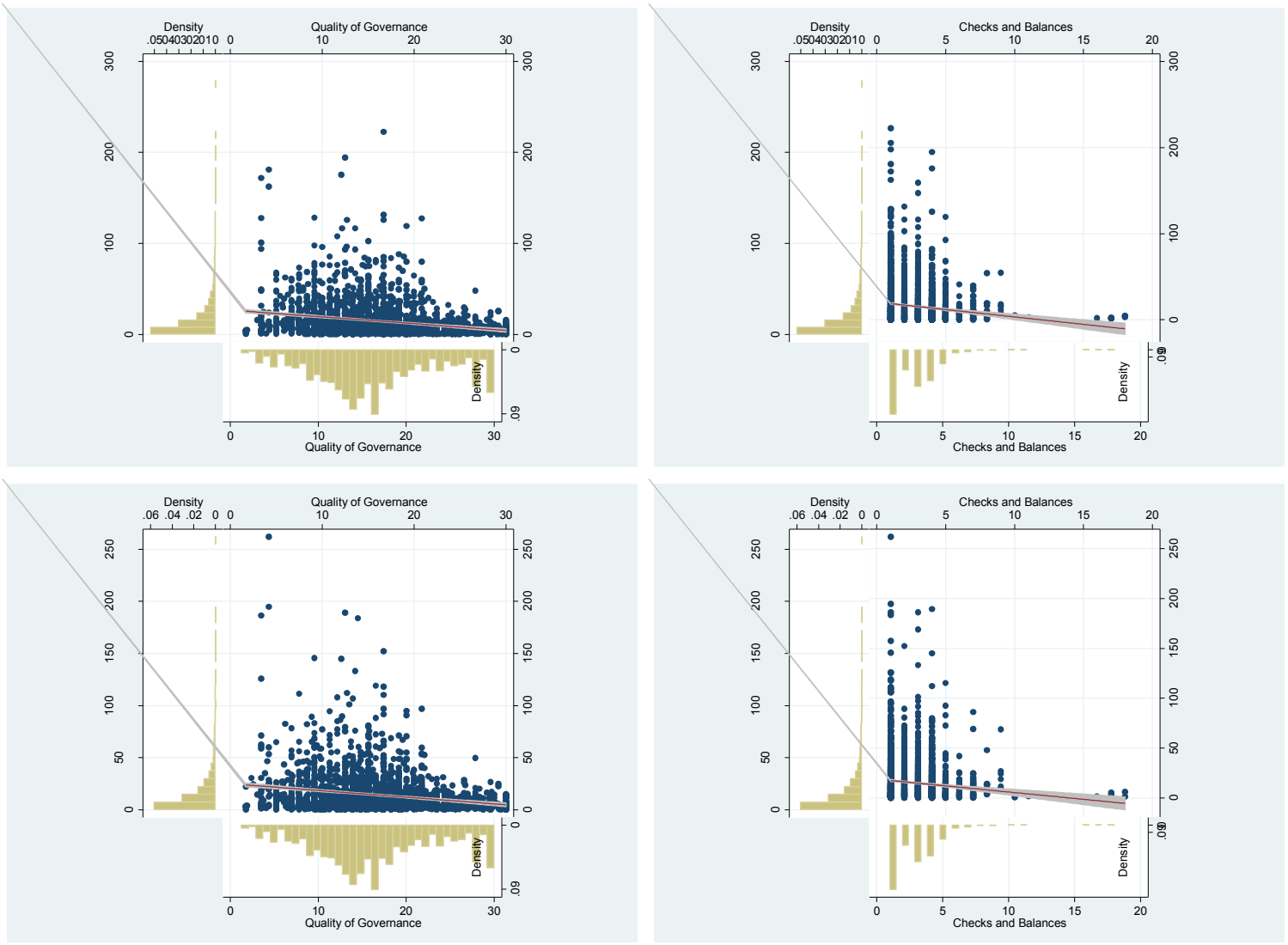
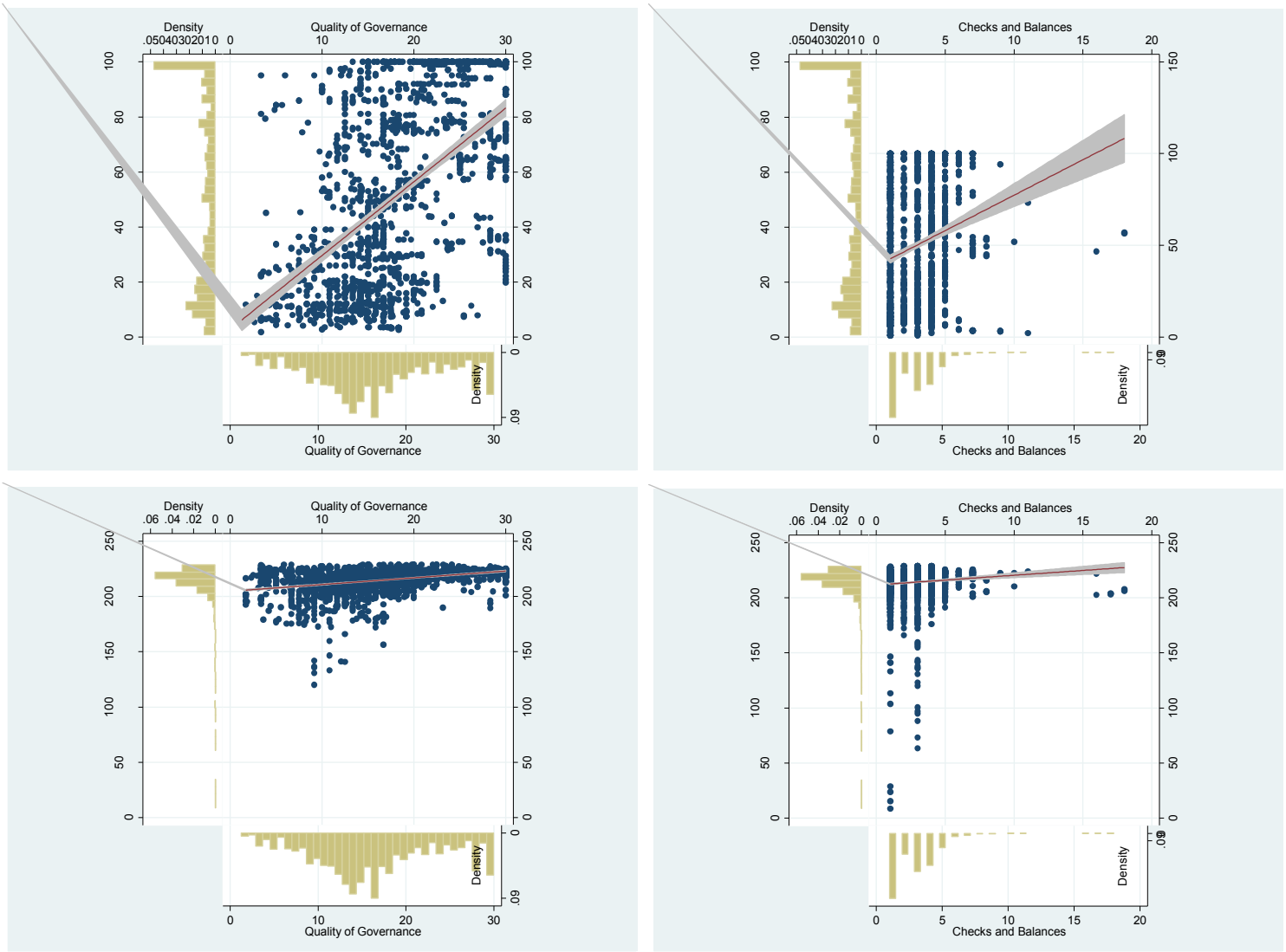


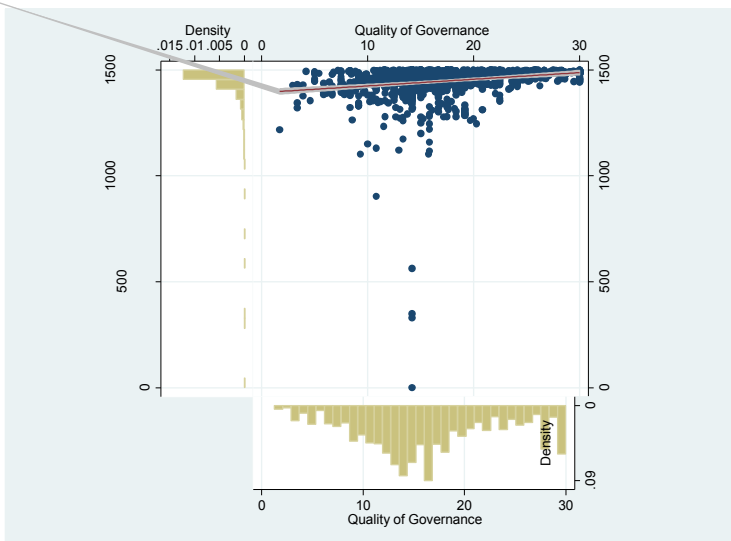
Table 3: Quality of Infrastructure per Quartile of Quality of Governance and Checks and Balances

	Obs.	Paved Roads / Total Roads	Obs.	Electric Power System Losses / Total Power Output (rescaled)	Obs.	Faults per 100 main (fixed) lines per year (rescaled)
Quality of Governance						
1st quartile	326	29.7	680	80.8	279	95.7
2nd quartile	341	38.3	773	84.8	282	95.9
3rd quartile	295	60.4	522	88.4	263	96.8
4th quartile	312	78.0	658	92.8	273	98.6
Checks and Balances						
1st quartile	417	44.7	892	84.1	381	95.3
2nd quartile	509	46.2	917	83.3	473	96.5
3rd quartile	309	53.8	542	88.4	255	96.9
4th quartile	254	67.4	422	89.0	204	97.0

Notes: The observations are the ones used in the regressions of the quality of infrastructure on institutional quality without controls.

Figure 3: Scatter plots, Probability Density Functions and Linear Predictions of Infrastructure and Institutional Quality




Density
.015 .01 .005 0
Quality of Governance
0 10 20 30
1500
1000
500
0
Density
Quality of Governance

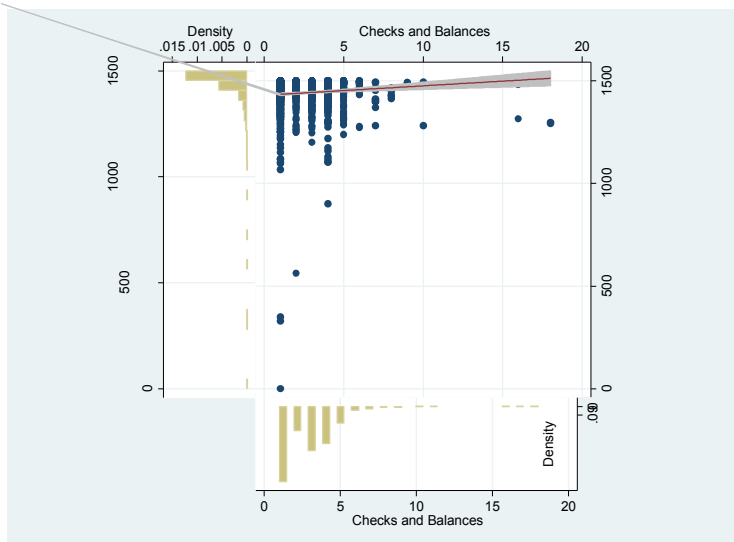

Density
.015 .01 .005 0
Checks and Balances
0 5 10 15 20
1500
1000
500
0
Density
Checks and Balances

Table 4: Descriptive Statistics

Variable	Obs.	Mean	SD	
			Across	Within
Public Investment / GDP	3254	6.7	4.4	3.2
Public Investment / Total Investment	3256	32.1	17.0	13.0
Volatility of Public Investment / GDP	3188	16.8	11.3	18.8
Volatility of Public Investment / Total Investment	3196	15.9	10.2	17.9
Quality of Governance	2490	15.9	5.6	2.6
Quality of Governance Wide	2490	28.3	7.6	4.0
Checks and Balances	3039	2.6	1.3	1.0
Checks and Balances Lax	3006	2.6	1.3	1.0
Bureaucracy Quality	2490	5.1	2.4	1.3
Corruption	2490	4.8	1.7	1.1
Law and Order	2490	5.9	2.0	1.3
Government Stability	2490	6.4	0.8	1.7
Democratic Accountability	2490	6.0	2.2	1.4
Population	3284	15.7	1.9	0.1
Leftist Party	3287	0.3	0.3	0.3
Price of Investment Goods	3097	68.9	41.0	35.3
Income per capita (growth rate)	3146	5.0	2.5	5.3
Conflicts	3287	0.1	0.1	0.2
ODA	3281	5.9	7.6	5.0
HIPC	3287	0.0	0.1	0.2
Revenues	3041	23.8	9.9	5.2
Rents	3147	5.7	12.0	6.4
Paved Roads / Total Roads	1433	47.5	31.4	4.8
Electric Power System Losses as a percentage of Total Power Outputs	2205	213.0	13.4	7.8
Faults per 100 main fixed lines per year	1328	1439.3	72.2	58.4

Notes: Data sources and units of measurement are presented in the Appendix.

Table 5: The impact of Institutional Quality on Public Investment/GDP

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag dependent	0.729***	0.567***	0.723***	0.564***	0.742***	0.567***	0.756***	0.776***
variable	(0.115)	(0.198)	(0.116)	(0.197)	(0.105)	(0.198)	(0.112)	(0.088)
Quality of	-0.037***		-0.039***		-0.036***		-0.031**	
Governance	(0.013)		(0.014)		(0.013)		(0.013)	
Checks and		-0.177		-0.159		-0.169*		-0.096*
Balances		(0.107)		(0.103)		(0.100)		(0.053)
Population			0.017	-0.134	0.005	-0.129	-0.002	-0.071
(log)			(0.071)	(0.118)	(0.067)	(0.119)	(0.067)	(0.054)
Leftist Party			0.383**	0.252	0.328**	0.201	0.300**	0.200
			(0.166)	(0.235)	(0.148)	(0.232)	(0.146)	(0.132)
Price of Investment					-0.006**	-0.004	-0.007	-0.008*
					(0.003)	(0.004)	(0.004)	(0.005)
GDP per capita							-0.013	0.002
							(0.019)	(0.019)
Constant	2.305**	3.538**	1.980*	5.595*	2.589**	5.873**	2.755**	3.658***
	(0.927)	(1.620)	(1.188)	(2.982)	(1.101)	(2.808)	(1.162)	(1.248)
Countries	116	144	116	144	115	143	114	141
Instruments	28	28	30	30	30	30	32	32
AR(2) test [*p*-value]	0.319	0.721	0.332	0.711	0.381	0.637	0.378	0.565
Hansen *J* [p-value]	0.713	0.644	0.751	0.621	0.806	0.912	0.737	0.224
Observations	2,359	2,874	2,356	2,871	2,210	2,705	2,156	2,614

Notes: GMM specifications include year effects and use lag 1 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: The impact of Quality of Institutional Quality on Public Investment/Total Investment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag dependent	0.701***	0.623***	0.720***	0.637***	0.702***	0.619***	0.681***	0.597***
variable	(0.124)	(0.088)	(0.132)	(0.091)	(0.128)	(0.094)	(0.126)	(0.104)
Quality of	-0.268**		-0.255**		-0.258**		-0.235**	
Governance	(0.110)		(0.115)		(0.112)		(0.111)	
Checks and		-0.684**		-0.582**		-0.723**		-0.736**
Balances		(0.291)		(0.277)		(0.301)		(0.301)
Population			-0.391	-0.522	-0.519	-0.541	-0.589	-0.685*
(log)			(0.374)	(0.328)	(0.397)	(0.346)	(0.462)	(0.404)
Leftist Party			1.705*	0.980	1.559*	0.747	1.224	0.659
			(0.886)	(0.861)	(0.864)	(0.897)	(0.780)	(0.877)
Price of Investment					-0.041***	-0.045***	-0.052***	-0.063***
					(0.015)	(0.016)	(0.018)	(0.021)
GDP per capita							-0.317	-0.318
							(0.373)	(0.484)
Constant	11.895**	12.765***	17.109	20.198***	22.839**	24.570***	27.628**	31.290***
	(5.052)	(3.167)	(10.405)	(7.519)	(10.375)	(7.793)	(11.582)	(10.538)
Countries	116	142	116	142	115	141	114	139
Instruments	28	28	30	30	30	30	32	32
AR(2) test [*p*-value]	0.992	0.722	0.928	0.781	0.968	0.751	0.975	0.636
Hansen *J* [p-value]	0.852	0.332	0.768	0.329	0.629	0.923	0.635	0.363
Observations	2,391	2,874	2,388	2,871	2,239	2,707	2,184	2,617

Notes: GMM specifications include year effects and use lag 2 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7: Extensions, the impact of Institutional Quality, Conflicts and Resources on Public Investment/GDP

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.754***	0.774***	0.751***	0.765***	0.751***	0.765***	0.599***	0.657***	0.597***	0.656***
variable	(0.114)	(0.088)	(0.118)	(0.091)	(0.118)	(0.091)	(0.094)	(0.100)	(0.094)	(0.097)
Quality of	-0.033**		-0.028**		-0.028**		-0.057***		-0.042***	
Governance	(0.014)		(0.013)		(0.013)		(0.016)		(0.015)	
Checks and		-0.097*		-0.068		-0.068		-0.097		-0.069
Balances		(0.053)		(0.049)		(0.049)		(0.068)		(0.065)
Population	0.008	-0.066	0.020	-0.025	0.020	-0.024	0.203	0.095	0.218	0.081
(log)	(0.071)	(0.054)	(0.076)	(0.051)	(0.076)	(0.051)	(0.138)	(0.086)	(0.138)	(0.090)
Leftist Party	0.301**	0.197	0.275*	0.173	0.275*	0.170	0.160	0.055	0.123	0.028
	(0.148)	(0.133)	(0.143)	(0.135)	(0.143)	(0.135)	(0.219)	(0.179)	(0.230)	(0.181)
Price of Investment	-0.007	-0.008*	-0.006	-0.007	-0.006	-0.007	-0.004	-0.006*	-0.001	-0.003
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)	(0.004)
GDP per capita	-0.013	0.002	-0.014	0.002	-0.014	0.002	-0.020	0.000	-0.016	0.003
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.015)	(0.018)	(0.016)	(0.019)
Conflicts	-0.290	-0.198	-0.281	-0.245	-0.281	-0.248	-0.418	-0.199	-0.504*	-0.262
	(0.282)	(0.233)	(0.279)	(0.238)	(0.278)	(0.239)	(0.289)	(0.244)	(0.262)	(0.229)
ODA			0.013	0.039**	0.013	0.040**	0.020	0.046***	0.030*	0.052***
			(0.014)	(0.016)	(0.015)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)
HIPC					-0.012	-0.109	0.164	0.103	0.235	0.082
					(0.224)	(0.246)	(0.265)	(0.274)	(0.267)	(0.284)
Revenues							0.053***	0.050***	0.041***	0.044***
							(0.015)	(0.014)	(0.014)	(0.014)
Rents									0.028**	0.017*
									(0.012)	(0.009)
Constant	2.632**	3.597***	2.316*	2.683**	2.318*	2.677**	-0.908	0.067	-1.615	0.031
	(1.172)	(1.234)	(1.201)	(1.093)	(1.201)	(1.092)	(2.281)	(1.459)	(2.219)	(1.493)
Countries	114	141	114	141	114	141	106	130	104	129
Instruments	33	33	34	34	35	35	36	36	37	37
AR(2) test [*p*-value]	0.392	0.571	0.397	0.583	0.396	0.583	0.576	0.424	0.921	0.264
Hansen *J* [p-value]	0.74	0.221	0.769	0.221	0.769	0.222	0.206	0.124	0.947	0.164
Observations	2,156	2,614	2,156	2,614	2,156	2,614	2,019	2,429	1,980	2,386

Notes: GMM specifications include year effects and use lag 1 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8: Extensions, the impact of Institutional Quality, Conflicts and Resources on Public Investment/Total Investment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.681***	0.597***	0.668***	0.598***	0.669***	0.599***	0.715***	0.583***	0.713***	0.608***
variable	(0.126)	(0.104)	(0.128)	(0.106)	(0.128)	(0.107)	(0.151)	(0.116)	(0.162)	(0.126)
Quality of	-0.239**		-0.213**		-0.211**		-0.255***		-0.182**	
Governance	(0.113)		(0.088)		(0.087)		(0.092)		(0.085)	
Checks and		-0.735**		-0.550**		-0.551**		-0.567**		-0.337
Balances		(0.301)		(0.273)		(0.273)		(0.288)		(0.253)
Population	-0.570	-0.689*	-0.511	-0.478	-0.508	-0.478	-0.047	-0.053	0.003	-0.173
(log)	(0.459)	(0.404)	(0.419)	(0.366)	(0.415)	(0.364)	(0.361)	(0.376)	(0.365)	(0.371)
Leftist Party	1.230	0.659	1.114	0.503	1.128	0.513	0.705	0.252	0.725	0.269
	(0.785)	(0.875)	(0.768)	(0.808)	(0.770)	(0.813)	(0.717)	(0.871)	(0.766)	(0.841)
Price of Investment	-0.052***	-0.063***	-0.049**	-0.058***	-0.049**	-0.058***	-0.046**	-0.060***	-0.030	-0.041*
	(0.018)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.018)	(0.023)	(0.026)	(0.024)
GDP per capita	-0.316	-0.305	-0.363	-0.511	-0.357	-0.505	-0.256	-0.444	-0.342	-0.478
	(0.371)	(0.480)	(0.425)	(0.571)	(0.431)	(0.577)	(0.341)	(0.425)	(0.355)	(0.437)
Conflicts	-0.577	0.235	-0.564	-0.123	-0.532	-0.110	-0.537	0.043	-0.992	-0.497
	(1.281)	(1.338)	(1.248)	(1.344)	(1.270)	(1.358)	(1.270)	(1.349)	(1.194)	(1.282)
ODA			0.074	0.196*	0.067	0.193*	0.038	0.205*	0.072	0.225
			(0.134)	(0.101)	(0.140)	(0.106)	(0.161)	(0.124)	(0.183)	(0.138)
HIPC					0.733	0.382	1.367	1.124	1.725	0.982
					(1.436)	(1.415)	(1.356)	(1.387)	(1.402)	(1.478)
Revenues							0.144***	0.132**	0.084*	0.074
							(0.051)	(0.052)	(0.044)	(0.046)
Rents									0.144**	0.177***
									(0.066)	(0.063)
Constant	27.349**	31.243***	26.373***	27.767***	26.197***	27.688***	13.435	17.262**	11.397	17.059*
	(11.437)	(10.443)	(9.581)	(10.104)	(9.594)	(10.137)	(8.728)	(8.427)	(8.871)	(8.779)
Countries	114	139	114	139	114	139	106	129	104	128
Instruments	33	33	34	34	35	35	36	36	37	37
AR(2) test [*p*-value]	0.980	0.642	0.996	0.650	0.996	0.652	0.669	0.931	0.712	0.970
Hansen *J* [p-value]	0.635	0.371	0.630	0.340	0.624	0.337	0.334	0.143	0.722	0.166
Observations	2,184	2,617	2,184	2,617	2,184	2,617	2,024	2,419	1,985	2,376

Notes: GMM specifications include year effects and use lag 2 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9: The impact of Resource Richness and Low Institutional Quality on Public Investment

	Public Investment / GDP		Public Investment / Total Investment	
	(1)	(2)	(3)	(4)
Lag dependent	0.600***	0.656***	0.722***	0.608***
variable	(0.093)	(0.097)	(0.160)	(0.126)
Quality of	-0.051***		-0.205**	
Governance	(0.018)		(0.098)	
Checks and		-0.075		-0.286
Balances		(0.073)		(0.299)
Population	0.228	0.081	0.034	-0.176
(log)	(0.139)	(0.090)	(0.352)	(0.370)
Leftist Party	0.166	0.030	0.846	0.247
	(0.232)	(0.183)	(0.743)	(0.847)
Price of Investment	-0.001	-0.003	-0.031	-0.042*
	(0.004)	(0.004)	(0.026)	(0.023)
GDP per capita	-0.015	0.003	-0.327	-0.470
	(0.016)	(0.019)	(0.349)	(0.434)
Conflicts	-0.492*	-0.263	-0.914	-0.482
	(0.259)	(0.230)	(1.165)	(1.277)
ODA	0.030*	0.052***	0.066	0.227
	(0.016)	(0.017)	(0.182)	(0.139)
HIPC	0.241	0.082	1.749	0.982
	(0.269)	(0.283)	(1.387)	(1.477)
Revenues	0.039***	0.044***	0.077*	0.072
	(0.014)	(0.014)	(0.041)	(0.045)
Rents	-0.023	0.014	-0.009	0.203***
	(0.034)	(0.016)	(0.155)	(0.074)
Quality of Gov. *	0.004		0.012	
Rents	(0.003)		(0.010)	
Checks and Bal. *		0.001		-0.011
Rents		(0.005)		(0.025)
Constant	-1.640	0.036	11.054	16.987*
	(2.176)	(1.491)	(8.621)	(8.754)
Countries	104	129	104	128
Instruments	38	38	38	38
AR(2) test [*p*-value]	0.885	0.263	0.707	0.971
Hansen *J* [p-value]	0.937	0.165	0.700	0.161
Observations	1,980	2,386	1,985	2,376

Notes: GMM specifications include year effects and use lag 1 of the endogenous variables in column (1) and (2) and lag 2 in column (3) and (4) with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 10: The impact of the subcomponents of Quality of Governance on Public Investment

	Public Investment / GDP		Public Investment / Total Investment	
	(1)	(2)	(3)	(4)
Lag dependent	0.597***	0.604***	0.607***	0.607***
variable	(0.094)	(0.092)	(0.094)	(0.092)
Bureaucracy	-0.059	-0.028	-0.516**	-0.420*
Quality	(0.048)	(0.044)	(0.239)	(0.230)
Corruption	-0.110*	-0.090*	-0.344	-0.242
	(0.062)	(0.051)	(0.226)	(0.219)
Law and Order	0.043	0.022	0.154	0.161
	(0.061)	(0.056)	(0.272)	(0.279)
Government		0.118**		-0.072
Stability		(0.048)		(0.241)
Democratic		-0.087		-0.311
Accountability		(0.060)		(0.247)
Countries	106	106	106	106
Instruments	39	41	42	44
AR(2) test [*p*-value]	0.541	0.516	0.626	0.628
Hansen *J* [p-value]	0.175	0.216	0.100	0.104
Observations	2,017	2,017	2,022	2,022

Notes: GMM specifications include year effects and use lag 1 in column (1) and (2) and lag 2 from column (3) and (4) of the endogenous variables with collapsed instrument matrix. Population (log), GDP per capita, Conflicts, ODA, HIPC, Revenues, Oil Exports and the constant term are included in all the regressions. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 11: The impact of Institutional Quality, Conflicts and Resources on the of Volatility Public Investment/GDP

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.405*	0.332***	0.419*	0.342***	0.420*	0.343***	0.385*	0.281***	0.350	0.269***
variable	(0.233)	(0.125)	(0.229)	(0.124)	(0.230)	(0.125)	(0.210)	(0.100)	(0.219)	(0.101)
Quality of	-0.610**		-0.495**		-0.493**		-0.525**		-0.458**	
Governance	(0.273)		(0.226)		(0.227)		(0.218)		(0.208)	
Checks and		-0.859**		-0.574		-0.578		-0.780*		-0.532
Balances		(0.397)		(0.379)		(0.378)		(0.409)		(0.412)
Population	-1.717**	-0.926*	-1.481**	-0.533	-1.478**	-0.543	-1.508**	-1.246**	-1.494**	-1.433***
(log)	(0.720)	(0.517)	(0.651)	(0.562)	(0.650)	(0.552)	(0.697)	(0.540)	(0.628)	(0.519)
Leftist Party	1.167	0.316	0.665	0.043	0.686	0.086	-0.064	-0.297	-0.202	-0.424
	(1.327)	(1.444)	(1.364)	(1.455)	(1.355)	(1.437)	(1.247)	(1.390)	(1.204)	(1.379)
Price of Investment	-0.041	-0.015	-0.034	-0.005	-0.034	-0.005	-0.003	0.021	0.006	0.042
	(0.049)	(0.048)	(0.050)	(0.050)	(0.050)	(0.050)	(0.051)	(0.056)	(0.056)	(0.070)
GDP per capita	1.950	1.987	1.946	2.036	1.946	2.025	2.032	2.084*	1.950*	2.200**
	(1.228)	(1.784)	(1.222)	(1.809)	(1.225)	(1.797)	(1.240)	(1.184)	(1.062)	(1.084)
Conflicts	-1.167	4.392	-1.095	3.958	-1.072	3.980	-1.125	4.068	-0.044	4.620
	(3.035)	(4.068)	(3.051)	(4.098)	(3.033)	(4.083)	(2.820)	(4.064)	(3.112)	(4.240)
ODA			0.222	0.331***	0.215	0.319***	0.230	0.335***	0.292*	0.407***
			(0.141)	(0.127)	(0.143)	(0.123)	(0.141)	(0.113)	(0.159)	(0.123)
HIPC					0.762	1.485	1.107	0.916	1.238	0.632
					(2.520)	(2.792)	(2.580)	(2.528)	(2.651)	(2.665)
Revenues							-0.038	-0.189*	-0.102	-0.267***
							(0.076)	(0.097)	(0.090)	(0.102)
Rents									0.168	0.223*
									(0.131)	(0.130)
Constant	31.727**	11.103	24.884*	1.462	24.771*	1.639	24.392*	17.328	23.688*	17.794
	(14.509)	(18.884)	(13.008)	(21.127)	(13.130)	(20.893)	(13.966)	(10.804)	(14.376)	(10.915)
Countries	114	141	114	141	114	141	106	130	104	129
Instruments	33	33	34	34	35	35	36	36	37	37
AR(2) test [*p*-value]	0.432	0.251	0.403	0.245	0.404	0.245	0.390	0.389	0.480	0.468
Hansen *J* [p-value]	0.858	0.727	0.866	0.730	0.865	0.727	0.910	0.751	0.914	0.684
Observations	2,118	2,559	2,118	2,559	1,985	2,381	1,983	2,379	1,946	2,338

Notes: GMM specifications include year effects and use lag 2 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 12: The impact of Institutional Quality, Conflicts and Resources on the Volatility of Public Investment/Total Investment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.267***	0.219***	0.268***	0.221***	0.267***	0.221***	0.293***	0.243***	0.292***	0.248***
variable	(0.053)	(0.054)	(0.053)	(0.054)	(0.053)	(0.055)	(0.049)	(0.055)	(0.049)	(0.054)
Quality of	-0.544***		-0.530***		-0.530***		-0.533***		-0.430***	
Governance	(0.141)		(0.147)		(0.147)		(0.137)		(0.146)	
Checks and		-0.897**		-0.808**		-0.810**		-0.724**		-0.460
Balances		(0.357)		(0.355)		(0.356)		(0.362)		(0.352)
Population	-1.181**	-0.989**	-1.152**	-0.863*	-1.151**	-0.868*	-0.988**	-0.855**	-0.943**	-0.966***
(log)	(0.477)	(0.477)	(0.456)	(0.463)	(0.457)	(0.461)	(0.426)	(0.408)	(0.412)	(0.369)
Leftist Party	1.167	0.703	1.112	0.606	1.110	0.632	0.378	0.162	0.355	0.104
	(1.169)	(1.338)	(1.133)	(1.312)	(1.129)	(1.306)	(1.025)	(1.253)	(1.005)	(1.127)
Price of Investment	-0.028	-0.049*	-0.028	-0.046*	-0.028	-0.046*	-0.024	-0.044	-0.026	-0.040
	(0.021)	(0.028)	(0.021)	(0.027)	(0.021)	(0.027)	(0.020)	(0.029)	(0.024)	(0.031)
GDP per capita	-0.135	-0.164	-0.139	-0.167	-0.139	-0.166	-0.137	-0.170	-0.120	-0.165
	(0.157)	(0.138)	(0.157)	(0.137)	(0.157)	(0.137)	(0.172)	(0.156)	(0.177)	(0.161)
Conflicts	-1.921	1.006	-1.907	0.908	-1.909	0.927	-2.943	0.008	-2.632	-0.138
	(2.639)	(2.561)	(2.647)	(2.573)	(2.647)	(2.577)	(2.685)	(2.613)	(2.765)	(2.678)
ODA			0.029	0.110*	0.030	0.103*	0.020	0.103	0.062	0.158**
			(0.068)	(0.058)	(0.072)	(0.061)	(0.072)	(0.065)	(0.085)	(0.071)
HIPC					0.027	1.050	0.432	1.300	1.186	1.379
					(1.630)	(1.840)	(1.628)	(1.836)	(1.649)	(1.761)
Revenues							-0.005	-0.075	-0.078	-0.154**
							(0.053)	(0.058)	(0.055)	(0.061)
Rents									0.195***	0.304***
									(0.073)	(0.080)
Constant	38.208***	31.801***	37.455***	28.884***	37.427***	28.896***	34.398***	29.981***	31.787***	30.076***
	(7.328)	(7.853)	(6.988)	(7.718)	(7.026)	(7.712)	(6.618)	(6.822)	(6.879)	(6.546)
Countries	114	139	114	139	114	139	106	129	104	128
Instruments	51	51	52	52	53	53	54	54	55	55
AR(2) test [*p*-value]	0.267	0.325	0.268	0.327	0.268	0.325	0.775	0.726	0.766	0.703
Hansen *J* [p-value]	0.129	0.501	0.129	0.506	0.131	0.490	0.213	0.759	0.282	0.662
Observations	2,150	2,569	2,150	2,569	2,150	2,569	1,994	2,377	1,955	2,334

Notes: GMM specifications include year effects and use lags 1 to 7 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 13: The impact of the subcomponents of Quality of Governance on the Volatility of Public Investment

	Public Investment / GDP		Public Investment / Total Investment	
	(1)	(2)	(3)	(4)
Lag dependent	0.689**	0.667**	0.296***	0.295***
variable	(0.313)	(0.320)	(0.049)	(0.048)
Bureaucracy	-0.014	-0.055	-0.574**	-0.675**
Quality	(0.562)	(0.594)	(0.288)	(0.287)
Corruption	-0.165	-0.010	-0.317	-0.415
	(0.637)	(0.651)	(0.414)	(0.460)
Law and Order	-1.076*	-0.879	-0.521	-0.515
	(0.579)	(0.567)	(0.369)	(0.361)
Government		-1.787		-0.008
Stability		(1.264)		(0.345)
Democratic		-0.003		0.317
Accountability		(0.372)		(0.342)
Countries	106	106	106	106
Instruments	39	41	57	59
AR(2) test [*p*-value]	0.271	0.355	0.725	0.721
Hansen *J* [p-value]	0.564	0.597	0.225	0.220
Observations	1,983	1,983	1,992	1,992

Notes: GMM specifications include year effects and use lag 1 in column (1) and (2) and lag 2 from column (3) and (4) of the endogenous variables with collapsed instrument matrix. Population (log), GDP per capita, Conflicts, ODA, HIPC, Revenues, Oil Exports and the constant term are included in all the regressions. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 14: The impact of Institutional Quality on the Quality of Infrastructure (Paved Roads/Total Roads)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.945***	0.926***	0.928***	0.918***	0.926***	0.923***	0.908***	0.896***	0.884***	0.892***
variable	(0.066)	(0.067)	(0.081)	(0.068)	(0.082)	(0.064)	(0.095)	(0.087)	(0.119)	(0.087)
Quality of	0.166		0.179		0.182		0.199		0.219	
Governance	(0.175)		(0.178)		(0.179)		(0.182)		(0.196)	
Checks and		0.225		0.127		0.125		0.222		0.162
Balances		(0.210)		(0.144)		(0.140)		(0.211)		(0.173)
Population	0.134	0.080	0.111	-0.038	0.114	-0.024	0.228	0.170	0.271	0.180
(log)	(0.161)	(0.128)	(0.158)	(0.140)	(0.160)	(0.130)	(0.305)	(0.224)	(0.368)	(0.233)
Leftist Party	-0.000	0.278	0.129	0.363	0.125	0.348	0.221	0.299	0.254	0.310
	(0.291)	(0.486)	(0.403)	(0.515)	(0.402)	(0.496)	(0.426)	(0.480)	(0.496)	(0.477)
Price of Investment	-0.001	0.002	-0.001	0.002	-0.001	0.001	-0.001	0.003	-0.002	-0.000
	(0.004)	(0.007)	(0.005)	(0.007)	(0.005)	(0.006)	(0.005)	(0.008)	(0.004)	(0.006)
GDP per capita	0.004	0.019	0.003	0.034	0.001	0.031	-0.002	0.031	-0.002	0.033
	(0.014)	(0.015)	(0.020)	(0.025)	(0.019)	(0.024)	(0.019)	(0.024)	(0.021)	(0.025)
Conflicts	0.045	-0.809	-0.026	-0.737	-0.063	-0.686	-0.242	-1.023	-0.112	-0.743
	(0.513)	(0.997)	(0.607)	(0.924)	(0.622)	(0.885)	(0.728)	(1.148)	(0.754)	(0.889)
ODA			-0.070	-0.123	-0.063	-0.109	-0.074	-0.122	-0.113	-0.143
			(0.078)	(0.099)	(0.073)	(0.088)	(0.079)	(0.102)	(0.122)	(0.116)
HIPC					-1.415	-1.584	-1.789	-2.057	-2.226	-2.227
					(1.177)	(1.183)	(1.389)	(1.531)	(1.841)	(1.600)
Revenues							0.028	0.072	0.057	0.088
							(0.051)	(0.073)	(0.087)	(0.085)
Rents									-0.052	-0.082
									(0.072)	(0.078)
Constant	-2.747	1.677	-1.300	4.542	-1.260	4.088	-2.908	0.601	-2.725	0.972
	(2.640)	(3.055)	(2.291)	(4.715)	(2.300)	(4.334)	(4.411)	(3.438)	(4.904)	(3.624)
Countries	127	154	126	153	126	153	118	142	118	142
Instruments	27	27	28	28	29	29	30	30	31	31
AR(2) test [*p*-value]	0.621	0.553	0.604	0.537	0.620	0.558	0.560	0.492	0.567	0.507
Hansen *J* [p-value]	0.371	0.559	0.403	0.616	0.389	0.580	0.430	0.669	0.461	0.630
Observations	1,189	1,383	1,172	1,365	1,172	1,365	1,092	1,273	1,069	1,250

Notes: GMM specifications include year effects and use lag 1 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 15: The impact of Institutional Quality on the Quality of Infrastructure (Electric Power System Losses as a percentage of Total Power Outputs – rescaled)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.737***	0.767***	0.729***	0.761***	0.731***	0.762***	0.719***	0.744***	0.708***	0.737***
variable	(0.053)	(0.032)	(0.056)	(0.036)	(0.056)	(0.036)	(0.066)	(0.047)	(0.055)	(0.048)
Quality of	0.181***		0.185***		0.183***		0.197***		0.142***	
Governance	(0.050)		(0.054)		(0.054)		(0.061)		(0.054)	
Checks and		0.266**		0.234**		0.236**		0.281**		0.152
Balances		(0.122)		(0.117)		(0.117)		(0.138)		(0.128)
Population	0.164	0.129	0.159	0.116	0.159	0.118	0.180	0.306	0.130	0.303
(log)	(0.134)	(0.146)	(0.140)	(0.143)	(0.139)	(0.143)	(0.157)	(0.214)	(0.155)	(0.218)
Leftist Party	-0.432	-0.462	-0.406	-0.370	-0.405	-0.373	-0.407	-0.586	-0.370	-0.645
	(0.415)	(0.483)	(0.439)	(0.477)	(0.437)	(0.476)	(0.499)	(0.625)	(0.434)	(0.590)
Price of Investment	0.005	0.009**	0.005	0.009*	0.005	0.009*	0.005	0.010*	0.003	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
GDP per capita	-0.021	-0.029	-0.020	-0.028	-0.020	-0.028	-0.015	-0.021	-0.012	-0.018
	(0.019)	(0.027)	(0.022)	(0.030)	(0.022)	(0.030)	(0.024)	(0.035)	(0.024)	(0.036)
Conflicts	-0.137	-0.449	-0.122	-0.368	-0.132	-0.378	0.039	-0.174	0.117	0.094
	(0.398)	(0.457)	(0.403)	(0.482)	(0.402)	(0.486)	(0.397)	(0.527)	(0.475)	(0.576)
ODA			-0.013	-0.072*	-0.010	-0.069*	-0.007	-0.066*	-0.017	-0.075**
			(0.026)	(0.037)	(0.027)	(0.038)	(0.032)	(0.040)	(0.027)	(0.037)
HIPC					-0.437	-0.521	-0.649	-0.551	-0.015	0.385
					(0.880)	(0.936)	(1.032)	(1.124)	(0.930)	(0.999)
Revenues							0.014	0.068**	0.043*	0.092***
							(0.015)	(0.028)	(0.025)	(0.032)
Rents									-0.087	-0.095*
									(0.057)	(0.056)
Constant	50.873***	46.926***	52.561***	48.607***	52.250***	48.414***	53.886***	47.129***	57.944***	49.382***
	(10.858)	(7.277)	(11.443)	(8.036)	(11.522)	(7.954)	(13.435)	(11.125)	(10.593)	(11.281)
Countries	119	127	119	127	119	127	110	116	107	114
Instruments	36	36	37	37	38	38	39	39	40	40
AR(2) test [*p*-value]	0.498	0.457	0.501	0.442	0.500	0.442	0.522	0.413	0.504	0.442
Hansen *J* [p-value]	0.296	0.316	0.365	0.211	0.357	0.222	0.229	0.176	0.278	0.337
Observations	2,443	2,585	2,431	2,572	2,431	2,572	2,226	2,330	2,168	2,273

Notes: GMM specifications include year effects and use lags 1 to 2 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 16: The impact of Institutional Quality on the Quality of Infrastructure (Faults per 100 main fixed lines per year – rescaled)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lag dependent	0.588***	0.625***	0.589***	0.621***	0.589***	0.621***	0.593***	0.619***	0.594***	0.611***
variable	(0.073)	(0.057)	(0.073)	(0.058)	(0.073)	(0.058)	(0.070)	(0.059)	(0.069)	(0.062)
Quality of	1.240***		1.104**		1.098**		1.043**		1.158**	
Governance	(0.424)		(0.433)		(0.433)		(0.419)		(0.501)	
Checks and		0.691		0.408		0.413		0.367		0.294
Balances		(0.853)		(0.834)		(0.835)		(0.888)		(0.932)
Population	-1.547	-0.546	-1.704	-0.847	-1.671	-0.812	-1.650	0.418	-1.607	0.291
(log)	(1.768)	(1.334)	(1.742)	(1.393)	(1.749)	(1.404)	(1.736)	(1.336)	(1.729)	(1.308)
Leftist Party	-2.660	-2.395	-2.243	-1.929	-2.251	-1.939	-2.211	-2.228	-2.664	-2.918
	(2.622)	(2.534)	(2.618)	(2.411)	(2.615)	(2.411)	(2.858)	(2.492)	(2.903)	(2.559)
Price of Investment	0.002	0.025	0.012	0.034	0.010	0.033	0.018	0.045	0.009	0.042
	(0.066)	(0.083)	(0.064)	(0.084)	(0.063)	(0.083)	(0.062)	(0.087)	(0.070)	(0.105)
GDP per capita	-0.048	-0.259*	0.143	-0.174	0.138	-0.175	0.073	-0.237	0.079	-0.222
	(0.155)	(0.139)	(0.168)	(0.174)	(0.166)	(0.173)	(0.167)	(0.194)	(0.174)	(0.201)
Conflicts	-6.589	-10.036**	-7.012	-9.667**	-7.176	-9.781**	-5.610	-7.953*	-5.621	-7.907*
	(5.830)	(4.149)	(5.797)	(4.187)	(5.801)	(4.197)	(5.677)	(4.159)	(5.623)	(4.279)
ODA			-0.179	-0.390***	-0.153	-0.371**	-0.134	-0.326**	-0.097	-0.358**
			(0.138)	(0.146)	(0.141)	(0.150)	(0.157)	(0.154)	(0.155)	(0.158)
HIPC					-3.489	-2.909	-3.338	-2.076	-3.920	-2.961
					(4.637)	(4.159)	(4.663)	(4.242)	(5.247)	(4.662)
Revenues							0.100	0.513**	0.059	0.549**
							(0.128)	(0.213)	(0.124)	(0.216)
Rents									0.212	-0.096
									(0.229)	(0.218)
Constant	623.571***	570.572***	623.522***	582.007***	622.316***	581.116***	615.480***	554.662***	611.802***	568.986***
	(119.196)	(96.383)	(119.375)	(99.195)	(119.301)	(99.095)	(114.895)	(93.885)	(111.616)	(97.887)
Countries	119	146	118	145	118	145	112	136	110	134
Instruments	33	33	34	34	35	35	36	36	37	37
AR(2) test [*p*-value]	0.483	0.403	0.479	0.394	0.479	0.394	0.478	0.407	0.478	0.415
Hansen *J* [p-value]	0.421	0.496	0.392	0.431	0.395	0.435	0.500	0.337	0.486	0.463
Observations	1,043	1,248	1,041	1,246	1,041	1,246	963	1,143	942	1,119

Notes: GMM specifications include year effects and use lag 1 of the endogenous variables with collapsed instrument matrix. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 17: The impact of the subcomponents of Quality of Governance on the Quality of Infrastructure

	Paved Roads/Total Roads		Electric Power System Losses as a percentage of Total Power Outputs - rescaled		Faults per 100 main fixed lines per year - rescaled	
	(1)	(2)	(3)	(4)	(5)	(6)
Lag dependent	0.913***	0.909***	0.707***	0.706***	0.590***	0.593***
variable	(0.095)	(0.098)	(0.063)	(0.063)	(0.071)	(0.070)
Bureaucracy	0.217	0.259	0.348**	0.385**	1.463	1.688
Quality	(0.173)	(0.215)	(0.163)	(0.185)	(1.091)	(1.150)
Corruption	-0.159	-0.156	-0.184	-0.144	-0.151	0.046
	(0.157)	(0.151)	(0.179)	(0.174)	(1.243)	(1.122)
Law and Order	0.507	0.508	0.341**	0.353**	1.768**	1.764**
	(0.510)	(0.512)	(0.149)	(0.152)	(0.810)	(0.816)
Government		0.185		-0.088		-0.172
Stability		(0.141)		(0.090)		(1.217)
Democratic		-0.093		-0.109		-0.670
Accountability		(0.143)		(0.102)		(0.736)
Countries	118	118	110	110	112	112
Instruments	33	35	42	44	39	41
AR(2) test [*p*-value]	0.615	0.658	0.515	0.521	0.479	0.477
Hansen *J* [p-value]	0.403	0.427	0.236	0.240	0.544	0.505
Observations	1,092	1,092	2,224	2,219	963	963

Notes: GMM specifications include year effects and use lag 1 in column (1) and (2), lags 1 to 2 in column (3) and (4), and lag 1 in column (5) and (6) of the endogenous variables with collapsed instrument matrix. Population (log), GDP per capita, Conflicts, ODA, HIPC, Revenues, Oil Exports and the constant term are included in all the regressions. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.